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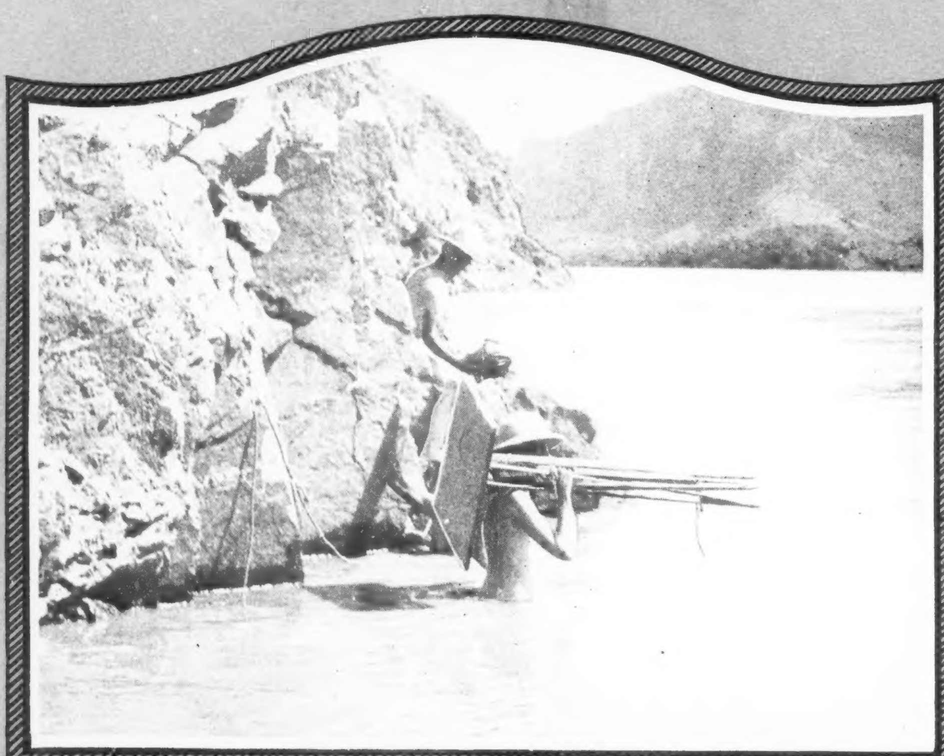

SURVEYORS WORKING AT COLORADO RIVER INTAKE OF AQUEDUCT THAT WILL CARRY WATER TO LOS ANGELES AND ASSOCIATE CITIES

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As It Seems To Us

FARADAY'S CENTENARY

EVERY whirling dynamo, every spinning motor—no matter of what size—is a monument to MICHAEL FARADAY. Without his epoch-making discovery of the phenomenon of electro-magnetic induction we might still be awaiting the production on a commercial scale of that form of energy which gives us light and power and which is ours merely for the pushing of a button or the throwing of a switch. We, in this country, employ annually billions of kilowatts of electric current that do myriads of things for our comfort, our convenience, our safety, and our pleasure. Indeed, life without abundant electricity at our command would be far different and less enjoyable than it now is.

We, as well as the rest of the world, are fundamentally indebted to FARADAY for the benefits derived through the workings of this facile servant; and we can, at least in spirit, join the Royal Institution and the Institution of Electrical Engineers in their commemoration, in London, of the discovery made by FARADAY on August 29, 1831, which crowned his protracted experiments that had for their goal the conversion of magnetism into electricity. That was the problem that he set himself in 1822; and success was won only after nine years of continual quest.

MICHAEL FARADAY was the son of JAMES FARADAY, a blacksmith; and his practical father decided that MICHAEL should learn a trade—schooling, as understood then, was not for such of his modest social environment. In due season, Michael was apprenticed to a bookbinder; and well-nigh immediately his acquisitive mind was caught even more by the text pages than by the cover of the volume. Things scientific made an irresistible appeal to him; and an indulgent customer furthered this appetite for knowledge by giving the boy the shillings that bought him a seat to hear Sir HUMPHRY DAVY lecture at the Royal Institution. So closely did the youthful MICHAEL follow the lecturer, making the while copious notes which he subsequently elaborated, that the scientist promptly recognized the boy's genius when he read those notes and accorded the lad an interview. That interview caused the abandonment of bookbinding and the boy's employment as an assistant in DAVY'S laboratory.

We cannot here recount the steps by which MICHAEL FARADAY developed his amazing intellect and won for himself a preëminent position in his chosen field of electrical experimentation. His was the reasoning mind as well as the imaginative mind; and the results won step by step were the rewards of clear and brilliant thinking. He attacked his every problem with zest; and accomplishment aroused in him a delight that was almost boyish in its character. In so much of his work FARADAY blazed his way, and no failure, no obstacle deterred him for long. Chance played but little part in the revelations that came to him: virtually every achievement was the logical outcome of well-directed and intense concentration. Despite the honors won by him, FARADAY was never spoiled. COSMO MONKHOUSE has thus summed up that amazing man:

"Was ever man so simple and so sage,
So crowned and yet so careless of a prize!
Great Faraday who made the world so wise
And loved the labour better than the wage."

It is a matter of history how FARADAY wound several hundred feet of copper wire into the form of a hollow cylinder, and then connected the ends of that wire with a galvanometer. FARADAY had also a bar magnet about three-quarters of an inch thick and a little over eight inches long. The terminals of the magnet were connected with an electric cell. First FARADAY brought one end of his magnet close to the cylindrical coil, but there was not the faintest movement by the needle of the galvanometer. Then the experimenter advanced his magnet quickly into the coil, and the needle moved! When he retracted the magnet the needle moved again, and then and there, through mechanical movement, was disclosed the basic principle of the dynamo or electric generator.

It is upon that foundation that electrical apparatus of many kinds have been built in the succeeding decades until the wonderful things of the present have come into being. By that amazingly simple experiment, FARADAY fashioned the key that has opened to the world an inexhaustible storehouse of electric energy. No wonder the two institutions are bent upon commemorating fittingly, in approaching September, the centenary not only of that discovery but of the other things that FARADAY contributed to the same field of science.

GOLD OUTPUT IN CANADA

THE mines of Canada are turning out gold at the rate of $100 a minute, $6,000 an hour, and $150,000 a day. They work at the job 24 hours a day and seven days a week. The rate of output is increasing so fast that it is unlikely any other country can take Canada out of second world place for many years. Such is the manner in which *The Northern Miner* sums up the current activity in this particular field of Canadian endeavor.

The total production for the current year, so it is estimated, will reach the value of $57,000,000; and the belief prevails that the mines of our northern neighbor have not yet attained their maximum production.

EMPHASIS ON CORRECT ENGLISH

A RECENT news bulletin, issued by the Montana School of Mines, contains, among other informative items, the following significant announcement: "Probably the outstanding addition to the required curricula is the new course in English proficiency, necessary for graduation but not offering credit. The grade in this course is determined by the student's English in all courses, including technical and scientific papers throughout his college career, but particularly in the senior year."

We wish to emphasize the fact that we approve of any effort made by an educational institution towards improving the English used by its students in any part of their academic work. Betterment in this direction will inevitably return rich dividends. While correctness of speech is much to be desired, we feel, nevertheless, that special stress should be laid upon proficiency in written English. It is the written word that lasts longest and does the most in influencing or in informing the public at large. And it is the written word that helps the student when the spoken word has been forgotten.

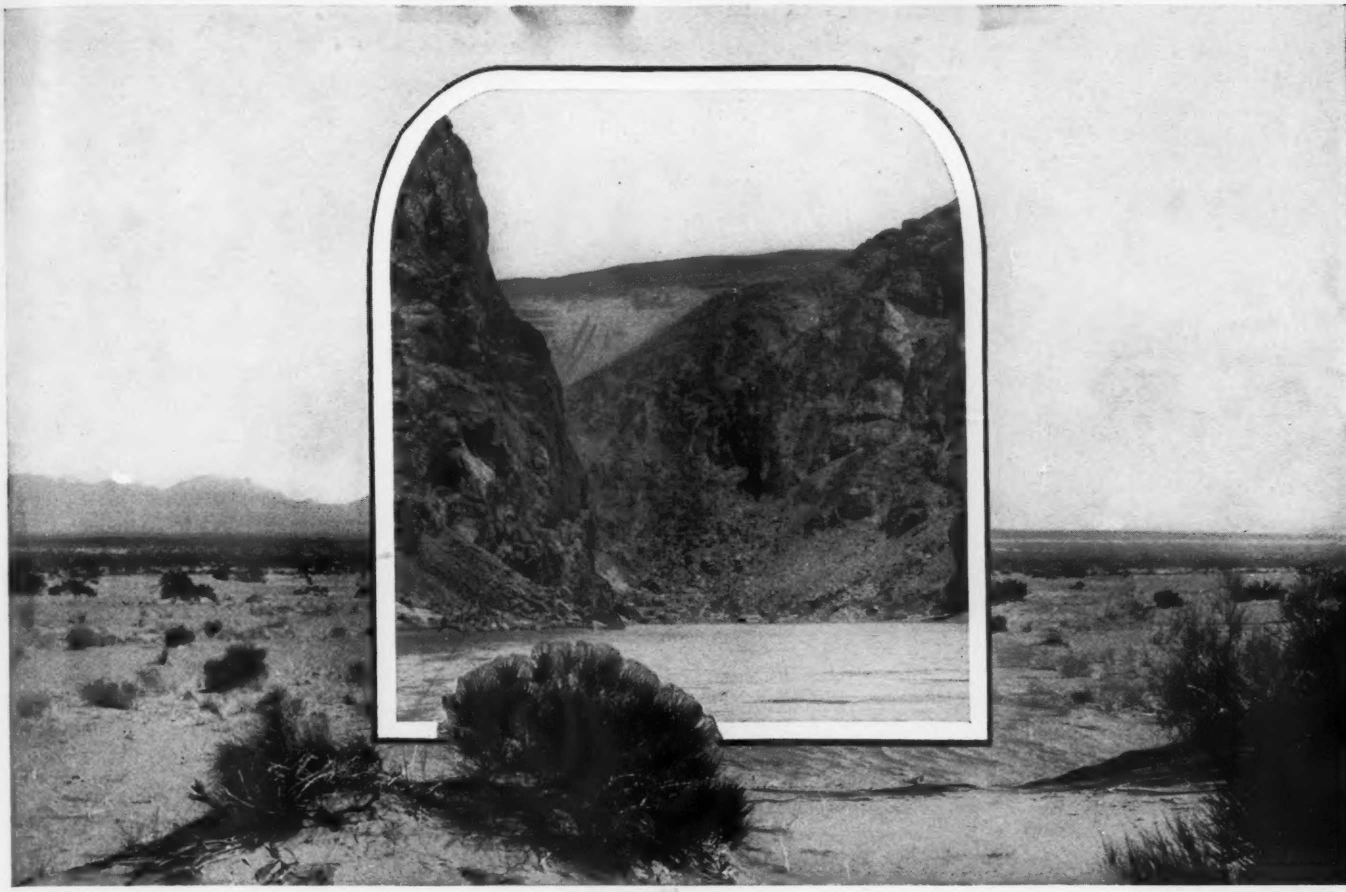
Professional men as a class are none too careful about the way they write—they conclude that the reader will gather the intended meaning; and it is common among these gentry to employ a vernacular—at times almost a jargon—peculiar to their respective callings. This practice may answer well enough among themselves, but the habit is not to be commended because it inevitably leads to slipshod and even beclouded expressions. The guilty ones should remember that all too often their written reports must, in the end, be read and, if possible, digested by men that are not similarly acquainted with the technicalities of the subjects treated. These persons may represent capital and may have the ultimate control of the disbursement of much desired or needed funds. Furthermore, the reports and papers of technicists may be the means of helping students to an understanding of things not covered in any fullness in textbooks. Accordingly, the writer on professional topics should look to his English.

It is with the foregoing view of the matter that we strongly urge that aptness in the choice of words, correctness in the use of accepted terms, and clearness in the presentation of any subject should receive proper weight in giving value to a student's proficiency in English. In short, we urge that proficiency be given "academic credit".

Our attitude towards this educational problem has been indicated on several occasions, but we believe something may be gained by repetition. No one will deny that a student's work becomes richer in its potentialities with the development of a gift of lucid expression.

Keystone View Company, Inc.

In the heart of Los Angeles' shopping and theater district.



All Photos, courtesy Metropolitan Water District

Contrasts: The Colorado River and the arid desert land over which the aqueduct will trace its way.

Los Angeles to Tap Colorado River With 265-Mile Aqueduct

By J. L. SPRING

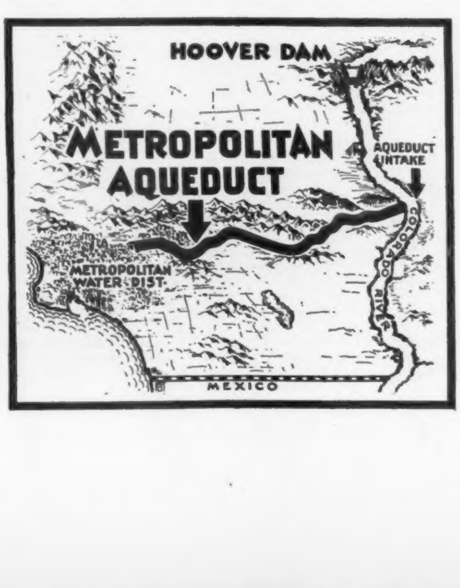
FOR countless centuries man has waged a well-nigh ceaseless war in certain parts of the world against his unrelenting enemy, the desert.

The Carthaginians, the Persians, the Babylonians, and many other peoples in their turn wrested from the pitiless desert sites for their cities in warm and arid regions. Man's really effectual weapon in this long-drawn battle has been water.

Water has made it possible for man to face undaunted seemingly insuperable odds and to surmount them, one by one, and to win for himself a firm foothold. In short, with water as his aid man has been able to transform barren and inhospitable wastes into territories capable of yielding him not only the essential things of life but even an abundance of luxuries.

Where water, once depended upon, has failed man, his material evidences of civilization have crumbled into dust that has become merged with the shifting sands of the desert. The significance of this is not commonly grasped by peoples fortunate enough to live and to thrive where water can usually be had in plenty; and among these favored ones there is little consciousness of the menace of a shortage of water that confronts numerous sections of the United States where populous communities have grown up amid circumstances that naturally do not encourage such expansions. Nevertheless, other conditions do favor settlement and development. In the course of progress the question of enough water becomes of paramount concern.

Many of us have accepted California as a typical land of fruits and flowers and a wealth of sunshine; but, true as this is, the sunshine would not alone produce horticultural abundance if it were not for the availability of a corresponding measure of beneficent water. With her continually augmenting population, with her ever increasing industries, and with the ever growing dependence of the country as a whole upon her fruitfulness, California, and especially the southern part of the Golden State, has awakened to the fact that her still more splendid future hinges upon the successful efforts of the engineers to whom she has entrusted the solution of her water problem.



Down on that rich plain between the mountains and the sea, the men of Southern California are preparing to stage a new act in this struggle of the ages. That is to say, Los Angeles and the fourteen other communities which comprise the Metropolitan Water District of Southern California are making ready to carry the battle farther afield in their conflict with the desert. These towns, namely, Anaheim, Beverly Hills, Burbank, Colton, Compton, Fullerton, Glendale, Long Beach, Pasadena, San Bernardino, San Marino, Santa Ana, Santa Monica, Los Angeles, and Torrance, have banded together to form the

1—Relatively diminutive man attacks the primordial rock with a "Jackhamer". 2—In this way a diversion tunnel is being driven in the massive wall of the river canyon. 3—An open-air blacksmith shop where drill steels are conditioned for tunnel driving. 4—A portable compressor supplies motive air to the oil furnace and the pneumatic sharpener in the blacksmith shop.

Floating machinery to scene of operations on the Colorado River.

District—a special governmental unit created by the State Legislature in 1927—for the purpose of solving their water problem by building a giant aqueduct that will deliver to them water from the Colorado River. The District, as an organization, has worked steadily towards the end desired, and everything is now set for an immediate and decisive battle. This project is linked in a manner with that still vaster undertaking, the Hoover Dam, higher up on the Colorado, in connection with which the Government has to date obligated itself to the extent of $49,000,000.

Already, steam shovels, air-driven rock drills, and blasting operations are disturbing the primitive quiet of Black Canyon, the site of the Hoover Dam; and from now on that region will be a focal point of intensified efforts for six or more years to come. Because of this work on the part of the Government, the directors of the Metropolitan Water District went unanimously on record recently in favor of a bond issue to raise funds for the aqueduct "as soon after September 1 as practicable." Dam construction and bond-issue plans, however, are but manifestations of the fundamental, driving urge which has inspired the authorities. No great dam would have been conceived, no 265-mile aqueduct would have been planned, if Southern California had not need of more water.

Mapping the course over which the 265-mile aqueduct will be built between the Colorado River and the Metropolitan Water District.

The association between the Hoover Dam and the aqueduct is this: the Hoover Dam will so regulate the flow of water in the Colorado that there will be enough water at all seasons for diversion into the intake of the aqueduct—otherwise the aqueduct would be affected by the vagaries of the flow of that extremely uncertain stream and, for considerable periods, might not have available water for the benefit of distant Los Angeles and its allied communities.

For a goodly number of years, engineers and geologists had predicted a water shortage on the great coastal plain upon which have been reared Los Angeles and the other cities of the District. As is more or less widely known, what was once a desert has been transformed by man's well-directed efforts into a semi-tropical garden, but only through the lavish expenditure of indispensable water. Indeed, the history of the amazing Southwest has gone forward coincidently with the present history of water development. When water came, people came, and verdure and prosperity gathered apace. The discovery of every new water supply has been followed by a great stride in population. And, conversely, without water the coastal plain would soon relapse into the desert region it once was.

To bring to pass what so far has been accomplished, enterprising Southern Californians have gone far afield for their water supply. Deep wells have been drilled to tap sources lying beneath the arid surface. Hundreds and hundreds of these have served their purpose but have, incidentally, lowered to 100 feet and more the erstwhile level of the ground-water table, adding substantially to the cost not only of reaching the water but of raising it to the surface for distribution.

It is not all dry work for the surveyors.

A great aqueduct was built by the City of Los Angeles to tap the Owens Valley, more than 200 miles away in the Sierra Nevada Mountains. Engineering skill has been displayed at every turn, and physical difficulties have been mastered by the men responsible for these really monumental undertakings. These achievements constitute a record of work well done and ample assurance of the efficient manner in which the projected aqueduct from the Colorado River will be constructed when authority to go ahead is given.

The water so far available has constituted, so to speak, the foundation upon which Southern California has arisen as an industrial empire and a region of endless attractions. But it is fully realized that this foundation must be amplified if the region is to maintain the place it has gained and is to be able to accommodate the growth that is reasonably assured. Engineering investigation has disclosed that Southern California is taking daily from its underground source quite 170,000,000 gallons of water more than is being put back into the ground by man or nature. Neither snows nor rains have been sufficient for a goodly while to replenish the tremendous drain entailed by an ever-increasing population.

This process of taking away and putting nothing back cannot go on indefinitely without causing loss or possibly disaster. A simple experiment with a bank account will prove the correctness of this statement. The man who checks indefinitely on his reserve fund, without making deposits the while, will eventually find his account entirely on the red side of the ledger. The same holds true of the California water account; and the danger of overdrawing a water account is just as serious to a city or a district as the danger of overdrawing a bank account is to an individual. The cities of the Metropolitan Water District are now preparing to prevent the exhaustion of their water bank account by building the proposed aqueduct from the Colorado River to their homes and their factories. In other words, instead of preparing for a rainy day, Southern California must prepare for a dry day. Coincidently with the water overdraft of 170,000,000 gallons daily, wells generally on the coastal plain have dropped continually with the passing years. This drop has ranged from 3 to 15 feet every summer—depending upon the amount of water that has sunk into the ground during the wet season.

With the realization of the foregoing facts and the inescapable need of a new source of supply, the constituted authorities set about making an exhaustive survey looking to relief on a scale that would provide enough water for a good many years to come. As a result of this examination, the Colorado River proved to be the only source available with water in sufficient quantity to meet the requirements of the Metropolitan Water District of Southern California. With the building of the Hoover Dam, 30,500,000 acre-feet of water will be stored in a lake 110 miles long. But the river and the cities that will make use of a portion of the water to be so impounded are separated by 265 miles of desert and mountains! Thus were the District engineers faced with the tremendous problem of finding a way to convey the water to the consumer. How was water to be carried over mountain ranges and across torrid desert prairies into the fertile area of the coastal plain? Without any parade, the engineers set about devising ways and means to unravel what seemed at first glance to be a truly staggering situation. For six years they examined wide stretches of territory to ascertain which of several possible routes would answer best for the line along which to lay and to drive the various sections of the great aqueduct.

In all, detailed studies were made of an expanse of more than 60,000 square miles, a tract larger than the combined areas of the states of Iowa, Delaware, and Rhode Island. Every aspect of the problem was taken into consideration with the utmost care and with expert understanding of the subject. Even the underground secrets of the earth were probed. Core-drill rigs were sent out into the arid wastes to pierce deep down and to discover buried geological formations so as to disclose whether or not a firm foundation existed for the aqueduct. Nothing was left to speculation: every essential was determined beyond question.

Out of all this painstaking study came a recommendation from Chief Engineer Frank E. Weymouth for the adoption of the route now known as the Parker Line. Of the 6[?] different routes exhaustively investigated, Weymouth declared positively that the Parker Line was the cheapest, the safest, and from all points of view unquestionably the most suitable. His judgment in this matter was shortly afterwards confirmed by the Engineering Board of Review, composed of Thaddeus Merriman, A. J. Wiley, and Dr. Richard R. Lyman, three of America's most distinguished consulting engineers.

It will, therefore, be over the Parker Line that water from the Colorado River will find its way through the Metropolitan aqueduct to the several cities of the District. The aqueduct will have a maximum diameter of 1[?] feet; and what this means can be better grasped if the reader is reminded that the huge conduit will be large enough to provide passageway for the greatest of the locomotives used by the Union Pacific Railroad. It will be water, however, and not locomotives that

will travel through this titanic artery—water at the rate of nearly 1,000,000,000 gallons every 24 hours.

At several points along the proposed route, engineers have found that it will be much more economical to push the line through instead of around surface contours that nature has reared in the course of ages. Consequently, the experts have planned for a number of tunnels in such places. The longest of these underground links will be the San Jacinto bore, which will measure a matter of thirteen miles from end to end.

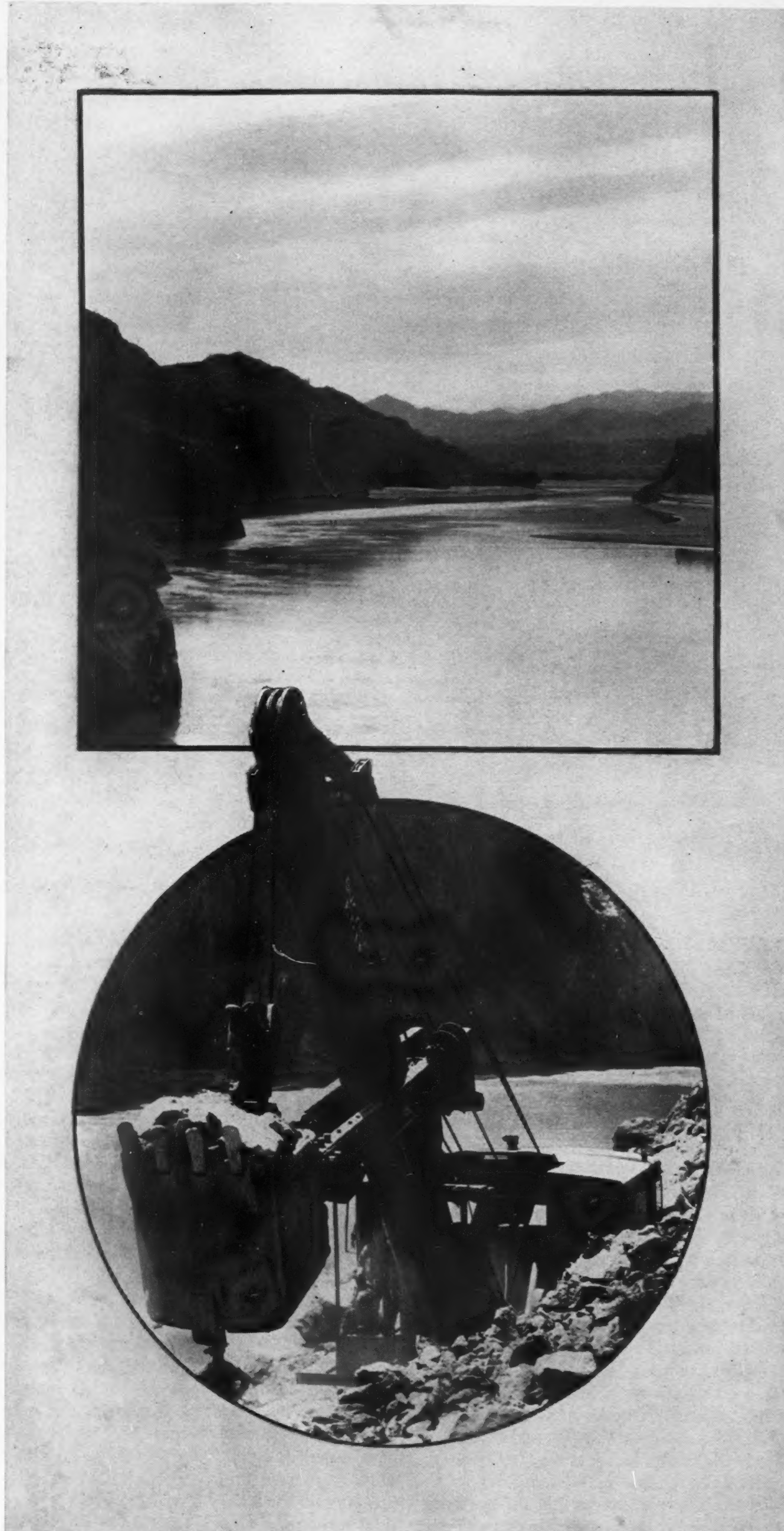
One feature commonly associated with aqueducts will be missing in the case of the Metropolitan conduit. Modern engineering does not make use of the arcade structures which the Romans built in so many instances to carry their water lines from one hilltop to another across intervening valleys. To meet situations of this sort the engineers of the twentieth century have perfected what they term the "inverted siphon", a giant steel tube that lies on the ground like a monster snake, extending from one high point down the slope into the valley and then up the second incline. Admittedly not so picturesque as the masonry viaducts that served the Romans as aqueducts, but, on the other hand, much more practical and far less costly.

The price to be paid for the Metropolitan aqueduct, which is to bring new water and the promise of a wider and fuller life to Southern California, will be in keeping with the economic benefits that will follow. It is estimated that a sum of approximately $200,000,000 will be expended in constructing it. This is a huge figure, and at first glance may tend to make the taxpayer hesitate; but when the sum is reduced to its more simple and generally understandable terms it loses a great deal of its initial impressiveness.

Statisticians have determined—even when counting upon the cost basis of $220,000,000—that the levy on the average taxpayer and water ratepayer will be small. This is because the aqueduct will be on a self-sustaining basis shortly after its building is completed, and, further, because a half century has been allowed for the retirement of the bonds. Let us make the situation still clearer.

District officials have ascertained that the yearly tax cost for the average taxpayer owning a $6,500 home will amount to $3.52—that is to say, the blessing of an abundant supply of water will be assured him at an outlay of less than one cent a day! For less than the price of a stick of gum or a penny box of matches, the majority of the taxpayers of the great Southwest will be able to pay for what will be the world's largest aqueduct. This is not merely participation in a monumental undertaking: it is the winning of a boon that cannot be measured in dollars and cents.

According to a statement prepared by the American Road Builders' Association, nearly $1,000,000,000 will be expended in 1931 by the various state highway departments on road construction and maintenance.



Top—Site of Parker Intake, 150 miles below Hoover Dam, where 1,000,000,000 gallons of water will daily be diverted from the Colorado River. Bottom—Giant power shovel at work in the depths of the age-old canyon through which the Colorado flows.

Sand Blast Effectively Plate

Forming a stencil by cutting away the protective coating of glue adhering to the glass to be decorated. The sand attacks only the bared glass.

CARVED or sculptured glass is being put to many decorative purposes at the present time; and the demand for glass so embellished is increasing day by day. Glass so adorned is but another response to the current craze for color and form that has its expression well-nigh everywhere in modern architecture, household appointments, dress, and in the multiplicity of other things forming the environment of the period.

Acid-etched glass, cut glass, and stained glass are familiar to most of us; and each and all of them are the results of efforts made to satisfy the varied conceptions of artistic decorations. Each, at its best, has definite limitations as to technique. Also, the size and shape of the piece of glass treated influence to a degree the nature of the embellishment and the extent to which the plain surface can be cut, etched, or otherwise ornamented. In some of these processes, the craftsman can qualify only after a protracted apprenticeship and a subsequent period of production in which he masters, step by step, the difficulties of his chosen calling. Obviously, the more skill required on the part of the artisan the more must be charged for his handicraft. As a consequence, glass so beautified is used in decidedly restricted quantities. Furthermore, the best of this kind of work is turned out in a somewhat leisurely fashion, and the necessary expenditure of time adds appreciably to the cost.

It is perfectly true, however, that where acid-etching suffices, or where other mechanical means furnish designs on glass that are pleasing principally because they relieve the flatness of a surface that has no arresting charm, such methods answer admirably. This is especially true where quantity of output is the first consideration and where a given design is reproduced over and over again. In the vast majority of cases where glass is etched or decorated for panels and the like, the treatment is "thin", that is to say, the glass is acted upon superficially and there is no depth to the design. It is this quality of depth that is much to be desired because of the play of light and shade which it induces. The problem was to find a relatively inexpensive process that would make the attaining of depth possible. The quest has been rewarded; and a process has been evolved that makes it practicable to carve glass speedily and to obtain effects rich in depth and modeling.

The modern fashionable store is up to date only when its show windows are adorned with decorative glass valances, when door transoms are embellished in a corresponding manner, and when wall panels of glass and show cases are also made appealing to the eye by the same means. A similar display of cut and figured glass can be seen in the latest of our hotels and theaters; and there is a tendency towards a wide use of glass of this sort in homes and apartment houses. Indeed, the demand for decorated glass grows apace. We have suggested merely a few of the well-nigh endless applications of this material. Glass thus fashioned and made effective has many minor but no less pleasing uses; and there is an ever widening employment of signs that are made more arresting in this way.

Undoubtedly, there are numerous plants engaged in satisfying this demand for adorned glass; but the newest of them are unquestionably utilizing the abrasive action of the sand blast to cut or to carve the glass. While the procedure may differ in particulars in each of these plants, still the fundamental process remains the same in all of them. Therefore, we shall make the state of the art clear to the reader if we tell him how such work is done in the establishment of the Plain View System, Inc. The products there range from single and repetitive panels with more or less complex designs to panels of large or small sizes upon which are cut decorative features of either robust or exquisite modeling, depending upon the dimensions of the sheet or slab of glass. All glass used is of the heavy-plate

Is Utilized In Carving Glass

By
SELAH CARR

The sand blast in action. The cutting force of the sand increases as the nozzle approaches the glass. An operator becomes very skillful.

variety, which permits of pronounced depth of cutting when the best effect can be realized in that way.

For the sake of easier understanding, let us follow the stages by which are produced a succession of panels of moderate size and carrying a conventionalized design—the panels to be placed either in a series of doors or in the wall spaces of one or more rooms. First, the artist or draftsman draws his design on paper, and that design is transferred by carbon paper to a number of other sheets of paper—the impression on each sheet being strong enough to give a satisfactory reproduction on the glass when the latter is suitably prepared. The glass is made receptive by attaching to it a thin sheet of paper that has been dipped in a fluid, white padding glue. The glue forms a film on each side of the paper; and when the glue has set, the sheet has a rubberlike appearance in texture. To attach a sheet to the glass it is necessary only to dampen the sheet and to smooth it against the glass with a moist, soft sponge. When dry, the coating so affixed is ready to receive the design preparatory to forming a stencil. The gummy material is cut away wherever the glass is to be attacked and cut with the aid of the sand blast.

First, the stencil cutter dusts the gummy surface with talcum powder to neutralize its stickiness, and then she lays the paper bearing the design face down on the coated glass. Next, she runs a small hand roller over the paper two or three times with sufficient pressure to effect a transfer, and, with this done, she removes the paper pattern. Wherever the design is lacking in crispness, the lines are brought out by light penciling. Everything is now in readiness for cutting the stencil. A sharp knife blade, set in a pencil-like handle, is used deftly and quickly in this work. As the cutting is completed on each area to be bared, the cutter lifts the coated paper at one point and skillfully strips the material to be removed. The visitor unfamiliar with the procedure shivers in anticipation of mutilation of the stencil, but somehow that calamity is avoided—the young woman being quite sure of herself and the correctness of her cutting strokes.

Should the worker make a mistake or tear the stencil unexpectedly, then the damage can be remedied by recoating that particular area—waiting, of course, until the glue has dried to the required degree. Like in everything else, expertness comes with time and practice; and the trained stencil cutter works so rapidly that it is found practicable and even economical to make in the manner described a stencil for each panel or piece of glass to be sand-blasted. Nevertheless, it does seem that time and money could be saved by making a master stencil of some material that would be sufficiently durable to permit the sand-blasting of a considerable number of identical designs. The wisdom of such a course would naturally be influenced by working conditions. A procedure of this sort is followed in some plants where wooden panels are "carved" by sand-blasting.

With the stencil cut upon the glass, the next stage of production rests with the sand-blast operator. Here, too, skill is born of experience; and the action of the sand blast—that is, its cutting vigor—depends upon the distance the nozzle is held from the surface of the glass. In addition to this, the operator has to exercise care in directing the sand blast. He must hold the nozzle perpendicular to the panel so that the abrasive sand will not undercut the stencil. Similarly, he must use judgment in the time he holds the blast at any one point lest the sand stream damage the stencil. The twofold coating of glue will resist the attack of the sand only for a limited period.

In making comparatively light cuts, a fine silica sand is utilized, while sand of the same sort but of a coarser grade is employed wherever a deeper cut is desired. In fact, the texture of the blasted surface will depend both upon the kind of sand used and the force

Photos, A. Halbran

This panel is carved to varying depths and with different sands to furnish contrasting textures, and is then stained with transparent colors to increase the artistic effect.

of the abrasive stream. Air for the blasting is delivered to the nozzle at a pressure of 100 pounds per square inch; and the operator, therefore, has at his disposal a tool susceptible of flexible handling and a fairly wide range of effectiveness. The myriads of particles of silica sand do for him what the carborundum wheel, the sandstone, or the graving tool would do for others; but the sand blast achieves the desired results far more quickly. This is because each abrasive grain is a cutting tool in itself.

Two of our illustrations show different stages in this present-day art of producing carved or sculptured glass, as it is also called, while the third picture gives a striking example of a large design characterized by decidedly effective modeling suggesting rounded or curved surfaces. The richness of the cutting is emphasized by the use of transparent colors applied on the engraved surfaces. This staining adds greatly to the artistic beauty of the design. Agreeably to the finish of the sand-blasted glass, the texture ranges all the way from a granular one to that having an exquisite silkiness. There is little cause for wonderment then, that this fairly new art has gripped the imagination and is lending itself both to decoration and to essentially practical applications in a great many fields of service.

COLOR FINISHES FOR ALUMINUM

THE familiar bluish-silver surface of aluminum may now be changed to any one of many colors by the use of chemical baths or electrochemical treatments, reports Arthur D. Little, Inc., in *Industrial Bulletin*. Aluminum, itself a durable metal, has in its own oxide a coating that is tenacious and stable. Aluminum oxide is pure white; but in coating commercial aluminum or its alloys, color is imparted by the minute particles of impurities or alloying constituents in the parent metal. Thus aluminum shingles, by treatment in a solution of certain carefully controlled chemical salts, are given a durable enamel-like coating of any desired shade of gray or brown.

Oxide coatings are also produced electrochemically when the aluminum article is made the anode in a suitable solution. This anodic treatment, resembling an electroplating operation but with the electrical current direction reversed, has become known in architectural foundries as "deplating". It is interesting to note that 5,000 aluminum spandrels with gray-oxide coating form part of the facade of the new Empire State Building in New York City. Anodic oxidation in chromic acid produces a coating of high corrosion resistance widely used on aircraft parts of duralumin alloys.

The same anodic-coating method, using a special solution, produces an oxide film with strong affinity for certain types of organic dyes. The coating may be dyed an almost infinite variety of colors and thus offers attractive possibilities for general commercial use. The dyed coating possesses a most pleasing depth of color. Light tones allow the metallic sheen of the underlying metal to merge with the color of the dye. Aside from color, the coating is hard, resembling the crystallized form of aluminum oxide, corundum. Thus an oxide film .0004 inch thick has been found to possess an abrasion resistance some five to ten times as great as five coats of baked enamel. Coatings about .0002 inch thick are satisfactorily resistant to wear and are sufficiently flexible not to crack with ordinary bending of the sheet. Thicker coatings may show some cracking on bending, but flaking from the metal does not occur.

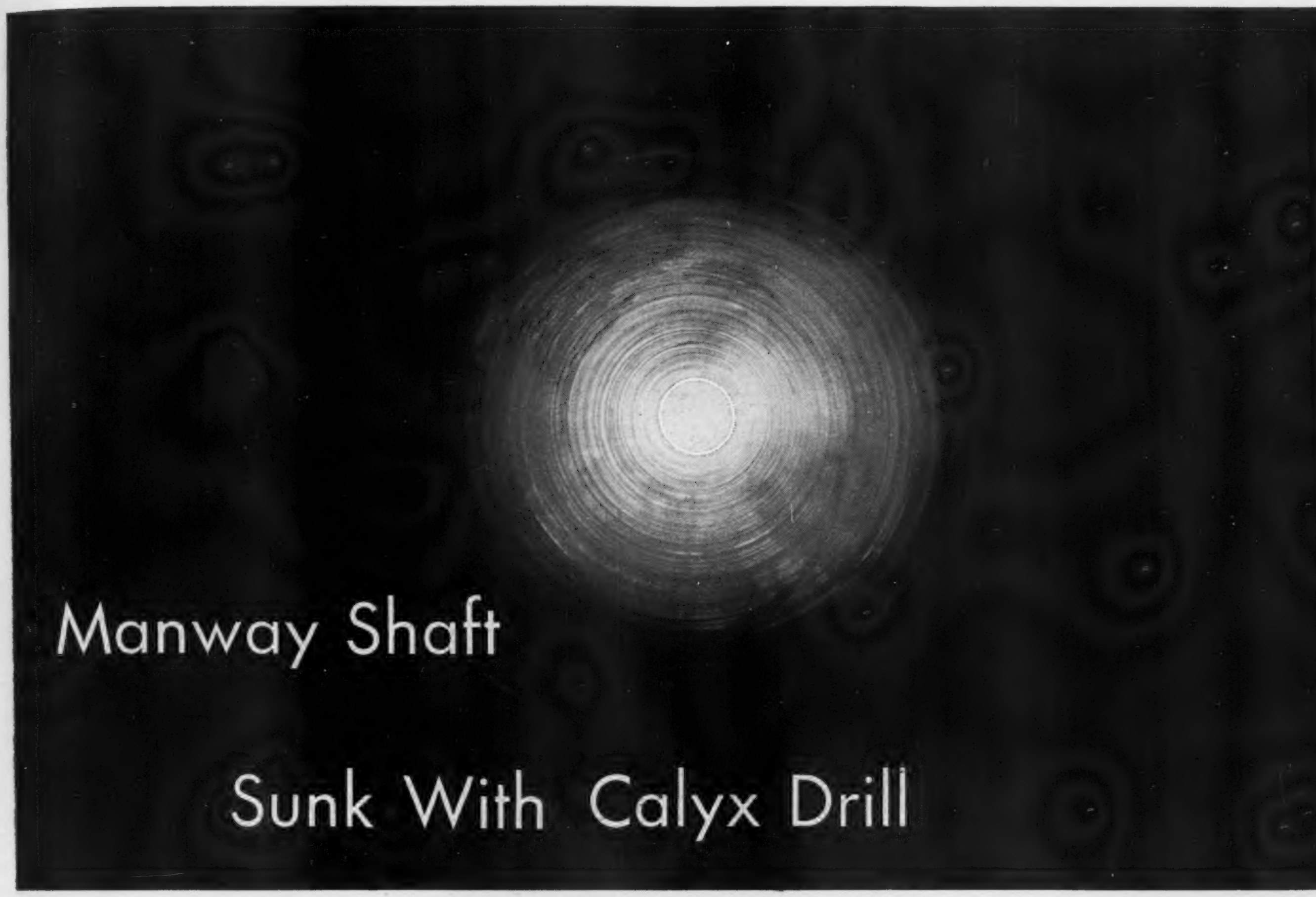
The surface texture of the dyed oxide finish varies with the texture of the metal before treatment. Polished aluminum produces a smooth enamel-like finish, while etched or even sand-blasted metal imparts a matte surface to the dyed film of oxide. These finishes may be waxed or lacquered. For outdoor service, a type of oxide coating is under development to permit tinting with mineral colors. Indoors, the more stable organic dyes are quite free from fading troubles, but they cannot as yet be recommended for general outdoor use.

NEW ALLOY SUPERIOR TO LEAD FOR WATER PIPING

WATER mains of the new ternary-lead alloy discovered by the British Nonferrous Metals Research Organization are being laid in the City of Manchester, England, and the belief is that that metal will take the place of lead as now used in the manufacture of piping for water-supply service.

Ternary-lead pipe weighs 33 per cent less than pure lead pipe, has 84 per cent more tensile strength, and its resistance to vibration is 217 per cent greater. Vibration, it should be borne in mind, is the principal cause of pipe breakage. The new alloy is composed of 98.25 per cent lead, 1.5 per cent tin, and 0.25 per cent cadmium; and it is said that approximately 1,500 pounds of this metal will give the same footage of pipe as a ton of ordinary lead.

At the Hawthorne plant of the Western Electric Company there is a new rod and wire mill where a copper ingot 3½ feet long can be drawn into 2,200 miles of No. 42 wire.



Manway Shaft Sunk With Calyx Drill

Looking up through shaft sunk with Calyx drill.

By FRANK MILLER

WORK done in a new way may be of more suggestive value than actual accomplishment in the first instance. This is probably true of an interesting undertaking recently carried through at the Phillipsburg, N. J., plant of the Ingersoll-Rand Company. We refer to a manway shaft sunk by that company at a small mine on the property. The mine is utilized for the testing of various types of rock drills under conditions that fairly approximate those of a regular mine.

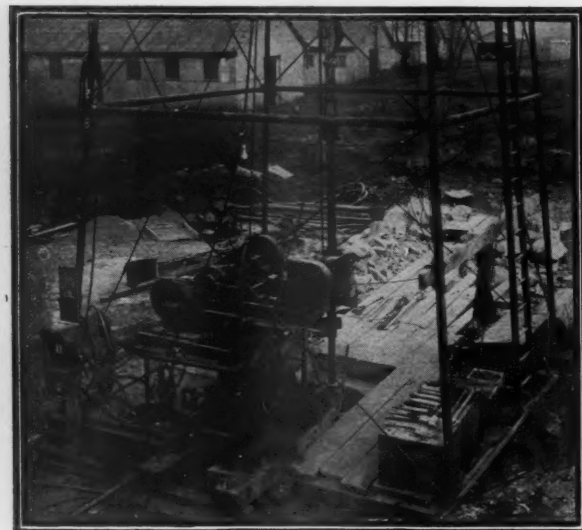
The experimental mine has been in service for some years, and the underground workings have been reached by a shaft sunk when the mine was first opened. As time went on, it was found desirable for several reasons to provide another entrance and exit to the mine to serve the dual function of a ventilating shaft and a manway. After due deliberation the decision was reached to drill a bore hole 36 inches in diameter—one large enough for use as a manway; and it was also decided that this shaft should be located in the mine at the meeting point of two connecting tunnels. Following the survey, it was arranged that the bore hole should tap the mine within 3 feet of the wall of one of the tunnels instead of piercing the tunnel roof. With these details settled, then arrangements were made for the boring of the shaft by an unusual method—that is, by employing a Calyx core drill equipped with a core barrel of a size that would cut a 36-inch hole.

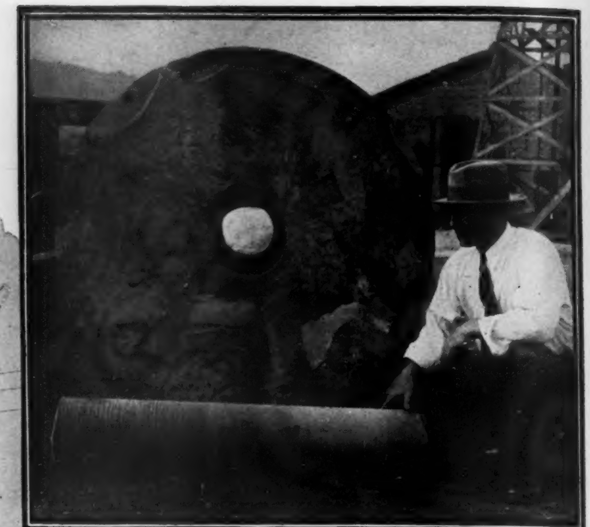
The rock to be penetrated was covered with an overburden 7 feet in depth; and a sufficient area had to be excavated to permit the setting up on the bared rock of a circular form having an inside diameter of 37 inches. When this form was in position, a space of about 12 inches was left between it and the surrounding earth. This space was filled with concrete until a circular curb was thus raised to a point 12 inches above the ground surface. After the concrete had set the form was removed, leaving a perfectly round concrete collar constituting a solid retaining wall reaching from the rock up through and above the depth of the overburden. This collar also played the part of a guide for the Calyx drill in the initial stage of penetrating the underlying ledge.

Where the Calyx drill cut through rock previously perforated by hammer-type drills.

Over the pit just described was erected a 60-foot derrick of tubular steel for the purpose of withdrawing and otherwise handling the drilling tools. There was also provided a small geared hoist operated with compressed air. With the necessary 36-inch core bit and rods at hand, everything was in readiness to start the shaft-sinking operations. The Calyx drill employed was of the well-known "WS" Type, which is now being widely used in conjunction with the wire saw in some of the slate quarries of Pennsylvania. The effectiveness of the Calyx drill in the slate region has been fully described in an earlier issue of *Compressed Air Magazine*. The success of the drill in this present case is the outcome of preceding unusual and satisfactory adaptations of the apparatus to the drilling of large holes.

The starting of the drill hole was a comparatively easy matter. About half a gallon of Calyxite was poured inside of the concrete wall on top of the rock, and several shovelfuls of clay were banked up in the center so as to guide the Calyxite under the bit at the outset. Of course, this method of directing the cutting material was not necessary after a groove had once been made in the ledge. The formation penetrated was of a hard blue





Left—Air-operated hoist and Calyx drill used in sinking the 36-inch manway shaft at the Phillipsburg experimental mine
Right—The sandstone core, 54 inches in diameter, that was cut with the Calyx drill, and the 10-inch center core removed from it in the same manner.
Bottom—Derrick of steel tubing set up to facilitate sinking the manway shaft.

lime rock. The first 15 feet was very much fractured, containing open seams which were large enough in many instances for a man to reach into for the full length of his arm. After 30 feet had been drilled, these open seams were closed by grout forced into them with compressed air—the operator doing this work being lowered down into the bore on top of the 36-inch bit, which made an excellent working platform for him. Owing to the broken nature of the formation, most of the cores were taken out in small pieces. The breaking of the core from the ledge after cutting was accomplished by drilling a hole with a "Jackhamer" in the center of the core and by firing therein a small piece of dynamite about the size of a walnut. This was done with an electric exploder. No trouble was experienced in cracking off the core in the formation encountered.

As soon as the powder smoke was blown out of the shaft, a man was lowered down into it in a small 18x24-inch bucket. The bucket was then loaded with the broken pieces and raised to the surface by the air-driven hoist. In many instances, large sections could be lifted out with a chain. Where the rock was solid, the core was brought up in one piece by driving a pin and wedge into the hole previously drilled with the "Jackhamer". Whenever the latter procedure was feasible, progress was at the rate of 6 feet in eight hours. The unwatering of the shaft was effected by using a bailer of a familiar mine type.

Undoubtedly, much better progress could have been made with a 48-inch hole, because a shaft of that diameter would have given the mucker more working space in removing the broken core. When finished, the shaft had a total depth of 75 feet. The average drilling speed was 3 feet 6 inches each 8-hour shift. This period covered the delay encountered when within 12 feet of the bottom of the shaft. From there on down, many mine drill holes were cut through at an angle, and these had to be plugged with clay to prevent the escape of the Calyxite into the tunnel from which those holes had been drilled.

When it is recognized that the shaft was sunk through a badly fractured formation and now stands without a stick of timber for support at any point, this use of the Calyx drill opens up a wide field of application. The smooth abrasive action of the drill in cutting through the ledge and the very small amount of explosives utilized show that it is entirely practicable to sink a shaft in this manner through rock without recourse to the blasting commonly required in doing work of this sort.

It is not claimed for the Calyx drill that it has universal application in shaft-sinking. Under many conditions, the ordinary procedure, using familiar rock drills, would probably answer best. However, it is equally manifest that there are certain circumstances in which the Calyx drill could be employed to advantage. Generally speaking, the Calyx drill would in all likelihood answer best in sinking shafts of moderate diameters, such, for example, as those intended to serve for ventilation or drainage or, possibly, as elevator shafts or as manways. In short, wherever the diameter is such as to seriously hamper the use of the rock drill, shaft-sinking could be done better, faster, and at less operating expense with a Calyx drill designed for that particular kind of work.

We doubt not that there are many among our readers who will get a helpful hint from what was done with the 36-inch "WS" Calyx drill at Phillipsburg. It may prove to be just the aid that will serve them in solving a puzzling problem. Indeed, it may be of interest to know that this selfsame apparatus has since been put to service elsewhere on a rock-drilling job of an unusual character.

RELINING AN OLD WATER TUNNEL WITHOUT HALTING FLOW

EVERY now and then in the pursuit of their work engineers are confronted with an unusual problem that calls for an unusual method of procedure and, as a rule, it is forthcoming. Such a situation arose and was successfully met in extending the London tube system from Finsbury Park to Cockfosters. At a point in the line the tube has to be driven beneath the New River where that river is carried through a brick tunnel built 300 years ago. The tube is to run just 25 feet below the old tunnel; and, as a matter of precaution, it was deemed advisable to strengthen that structure by relining it. This meant that the New River had to be diverted—the tunnel unwatered; and this had to be done without interfering with the flow that supplies a reservoir.

To accomplish this end there was constructed on the waterfront close to the site a steel main 90 feet long and 6 feet in diameter. This was sealed at both ends upon completion; rolled into the river; and towed and floated into proper position, where it was sunk. By means of suitable connecting dams the New River was then diverted and made to flow through the steel conduit. After the water left in the old brick tunnel had been pumped out, the work of relining was begun. When finished, the stream will be made to follow its old course by the simple expedient of removing the dams and the water main.

SIGNS
For Many Services

By S. G. ROBERTS

DANGER! Curve! Side Road!

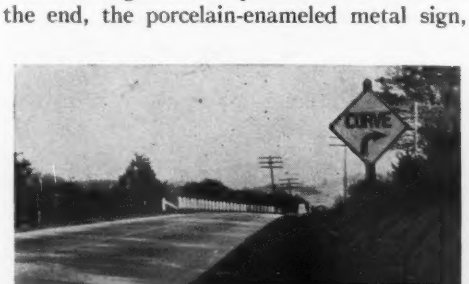
What motorist has not seen warnings of this sort as he hastened along any frequented highway?

These signs have a valuable and a vital service to perform. They forewarn the driver so that he may slow up or otherwise be sufficiently prepared to meet a situation that may develop a short distance ahead. Such markers promote rapid transit and they also increase the factor of safety. In short, they are necessary.

Traffic road signs are of numerous and varied descriptions, and each is designed to indicate a particular condition likely to be found not far away. They give help to persons unacquainted with the country over which they are traveling and put them on an equal footing with the residents who are usually familiar with the roads of the region. But traffic signs are not the only ones displayed by the roadside for the information of the man at the wheel. There are signs that suggest what to drink, what to eat, what to wear, where to stop, and so forth. A very large percentage of these signs, no matter what their object, are stamped out of sheet metal and so colored as to emphasize their visibility and to arrest attention.

Thousands of us must often have wondered where and how so many of these wayside signs or markers are made in order that there shall be enough of them to dot the far-flung routes and, in the case of traffic signs, to meet the particular need of each section of our changing highways. While large numbers of road signs are painted on wood, still preference is for those made of metal. To add to their weathering qualities, the best of these signs are porcelain enameled; and so finished they will last for years where a painted sign exposed to the same conditions will do well if it remain legible for a period of months. In the end, the porcelain-enameled metal sign, besides giving a greater length of satisfactory service, is also more economical.

Porcelain-Enameled Signs Win Increasing Favor Because of Their Durability.



The manufacture of porcelain-enameled signs is somewhat of an industrial specialism; and we can have a fuller understanding of the art if we follow what is done in an up-to-date plant engaged in this field of production. Through the courtesy of the Tennessee Enamel Manufacturing Company, we shall tell how metal signs are turned out in its factory in Nashville, Tenn. To begin with, the sheet iron used for this purpose is especially prepared to withstand the high heat of firing to which it is subjected when the enameling materials are being burned into the metal.

With the sheet iron cut in strips or blanks of suitable size for a given sign, then the blanks are run through a stamping machine fitted with dies that impress upon the metal the design or lettering required. The next operation cleans the stamped sheets of rust or any adhering oil. This is accomplished by dipping them successively into five or six different vats containing acid solutions of diminishing strengths—the last vat being filled with clear water. With the cleaning done, the stamped sheets are run into a drier; and when dry enough they are dipped into a vat where they receive their first protective coating. This ground coat is commonly a blue black; and it is made permanent by

Different views of the three ER-1 compressors that provide air for many purposes in the plant of the Tennessee Enamel Manufacturing Company.

being burned into the metal in a gas-fired or electrically fired furnace. In some cases the lettering or design upon the ground coat is placed there with a stencil or by the application of a decalcomania. Be this as it may, the design is fixed by burning.

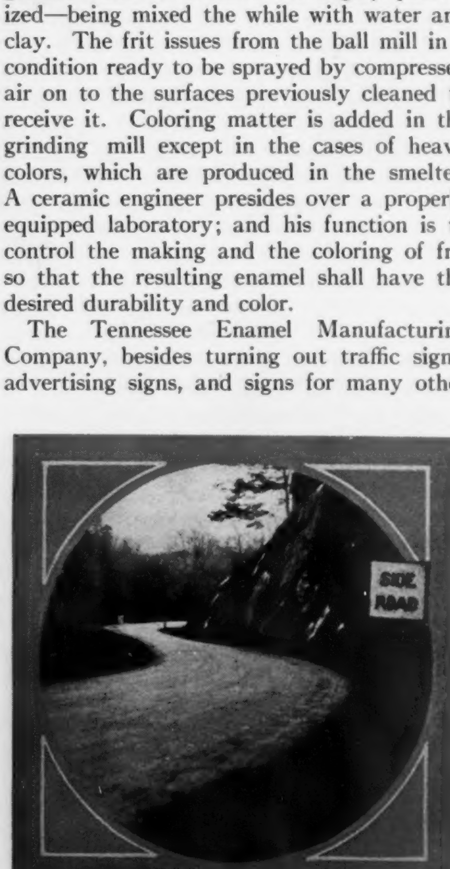
The procedure in preparing a more complicated sign of several colors entails more work and time. Each color is sprayed on to the sign separately, and it is made to cover the whole surface of the sign no matter what may have been previously applied underneath and burned. This means that the surplus film must be wiped off carefully where not desired before the piece goes into the furnace for the burning of that particular coat. The operators that do this preparatory cleaning soon become expert and do their work rapidly and deftly. There are in the plant about 30 booths where the enamel is sprayed on the products by compressed air—the products being delivered to and carried from the booths by a conveyor system. After they have been sprayed and dried, the signs are transferred to an overhead conveyor which delivers them to the electric oven for burning. At the completion of each operation the work is inspected.

The ovens employed to do the burning at this stage of production are of what is known as the continuous type. The heat is maintained precisely at each stage of the progress of a sign through a furnace. The article moves slowly from the receiving end to the discharge end: it reaches the section of maximum heat gradually, and, by corresponding steps, the temperature drops towards the outlet. The rate of travel averages about 11 or 12 feet per minute, and the speed varies with the ware. The maximum temperature is 1,600° F. Sheet-metal products require a burning time of approximately two minutes.

The enamels used have a vitreous base, known to the trade as "frit"; and at the Nashville plant the frit is made, ground, and mixed with water in a department devoted exclusively to that exacting work. The materials utilized in preparing the different colored frits are fluorspar, boric acid, zinc oxide, feldspar, cryolite, quartz, soda ash, sodium nitrate, borax, etc., etc. A suitable mix of some of these materials is placed in a smelter, which may be either oil fired or gas fired, and there the ingredients are melted in the course of something like four hours. When in the proper molten state, this glassy mixture is discharged so that it will fall in a glowing stream into a tank containing water. Contact with the water causes the material both to solidify and to fracture minutely and to break up into bits of differing sizes. This facilitates the operation that next follows.

The frit is placed in a ball mill where it is ground until it becomes thoroughly pulverized—being mixed the while with water and clay. The frit issues from the ball mill in a condition ready to be sprayed by compressed air on to the surfaces previously cleaned to receive it. Coloring matter is added in the grinding mill except in the cases of heavy colors, which are produced in the smelter. A ceramic engineer presides over a properly equipped laboratory; and his function is to control the making and the coloring of frit so that the resulting enamel shall have the desired durability and color.

The Tennessee Enamel Manufacturing Company, besides turning out traffic signs, advertising signs, and signs for many other

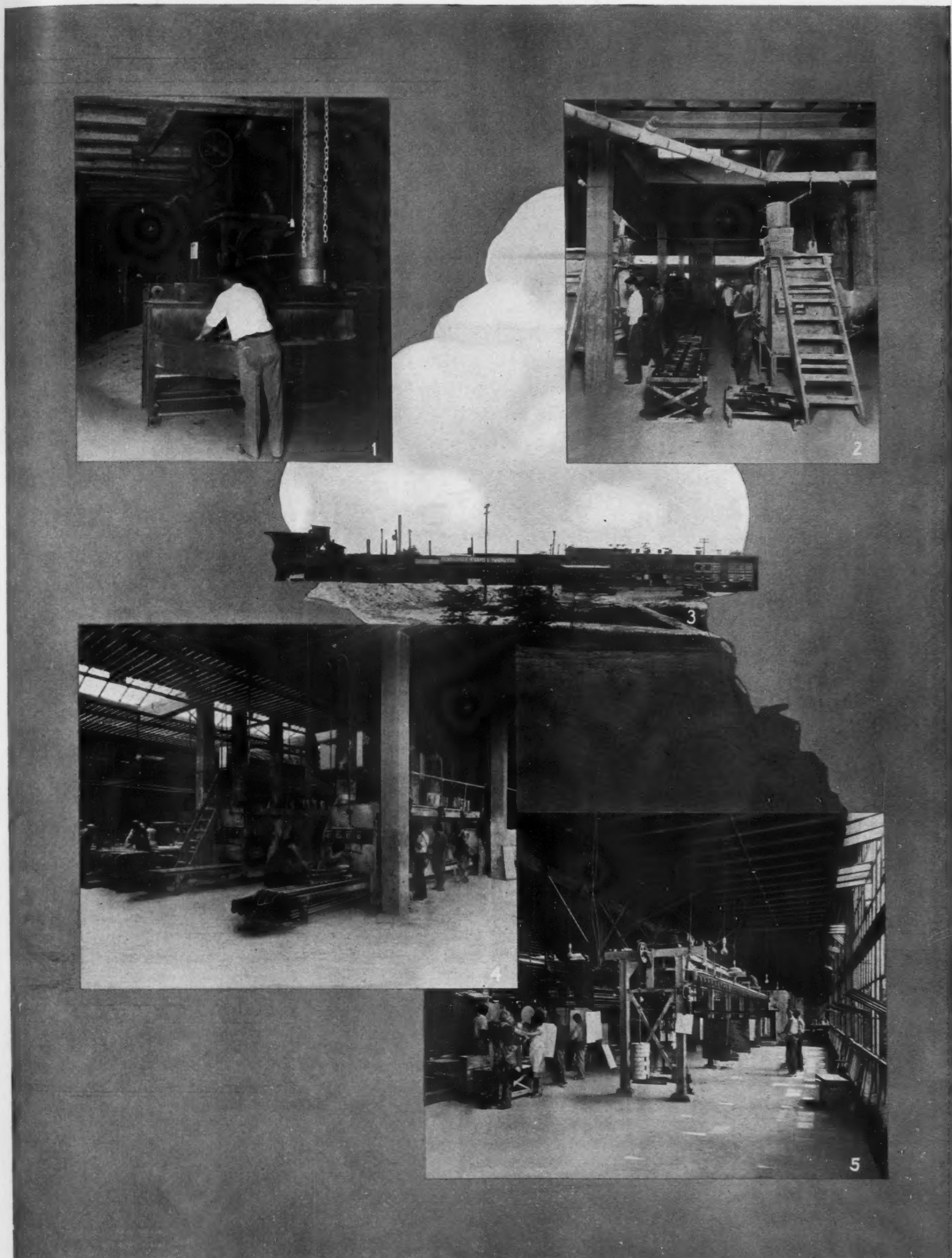


purposes, also produces from sheet metal table tops for breakfast rooms. These tables are made in a wide range of colors and are given different finishes. Some of them are grained to simulate wood; and the method of doing this is interesting. Formerly the practice was to use an etched copper plate to impress the design on the metal sheet before burning. Now a walnut panel is employed. The panel is coated with a film of frit and a roller is run over the panel to pick up the design, which is then transferred to the metal by running the roller upon the sheet. A walnut panel costs $15, while a copper plate suitably etched would entail an outlay of $700!

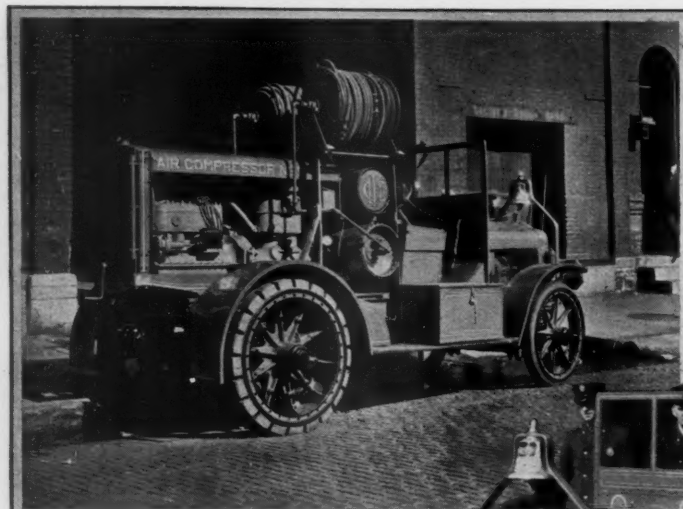
In addition to the commodities previously described, the Tennessee Enamel Manufacturing Company also finishes stove- and gas-range parts of divers sorts. All these iron castings are first cleaned by sand-blasting, and they must be absolutely clean to receive the porcelain enamel uniformly and properly. In this work the castings are exposed to the abrasive while resting on sand-blast tables. The plant is also provided with fully equipped Pangborn sand-blast rooms. When ready for enameling, the parts are air-sprayed with frit; and when this has been applied they are transferred to a furnace where the maximum temperature is 1,200°F. The burning operation takes about 25 minutes.

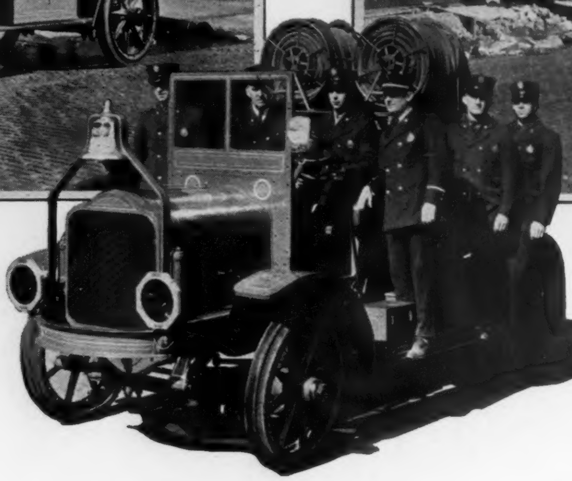
The fine and uniform finish obtained is the result of much care at every step, including nice control of materials, ingredients, and temperatures. The customer demands that this finish shall last for a long while in the service to which the commodity is put. It is said that porcelain-enameled road signs will stand all sorts of exposure for a guaranteed period of quite ten years.

To supply the considerable volume of compressed air needed, the plant is equipped with three ER-1 machines—two being 12x10-inch units and one a 14x12-inch compressor. A horizontal aftercooler is relied upon to remove any moisture from the air. A fourth 8x6-inch ER-1 machine is employed to compress to 30 pounds the gas that is fed to certain of the furnaces.



1—This sand-blasting machine is capable of handling 1,000 pounds of castings hourly. 2—Spray booths in the cast-iron department of the plant. Conveyor between booths carries sprayed castings to drier. 3—Plant of the Tennessee Enamel & Manufacturing Company, Nashville, Tenn. 4—Section of the sheet-metal spraying department. 5—Sprayed products traveling by conveyor to electrically heated furnace in middle distance.





Left—Portable compressor unit of the Chicago Fire Department—an innovation in its field of service. Right—The portable operating a "Jackhamer" during a demonstration at the Training College and Drill School maintained by the Department. Bottom—Air Compressor No. 1 and crew answering a fire alarm.

Portable Compressor as an Aid In Fire-Fighting

FIRE-Fighting is something more than directing water upon flaming areas. The successful outcome of such a battle may hinge both upon providing means of ventilating the involved structure and of furnishing passages through walls and floors through which hose may be led or water directed effectively against the burning surfaces. An experienced fireman knows all too well how a brick or concrete wall or a monolithic floor may hamper him and stand between him and the fire he wants to reach in haste.

Two years ago the wisdom of amplifying his facilities was brought home to the Fire Commissioner of Chicago. This was accomplished by a demonstration staged for the purpose. The object was to show in a convincing manner how a portable air compressor equipped with suitable air-driven tools could be used to marked advantage in supplementing the picks and axes and other manual aids commonly employed by firemen in cutting holes in walls or floors. As part of the arrangements for the test there was a concrete wall and a large slab of concrete—the slab simulating the floor of a concrete building. There was, besides, a wooden platform 6x6 feet square and 1 inch thick to represent an ordinary floor.

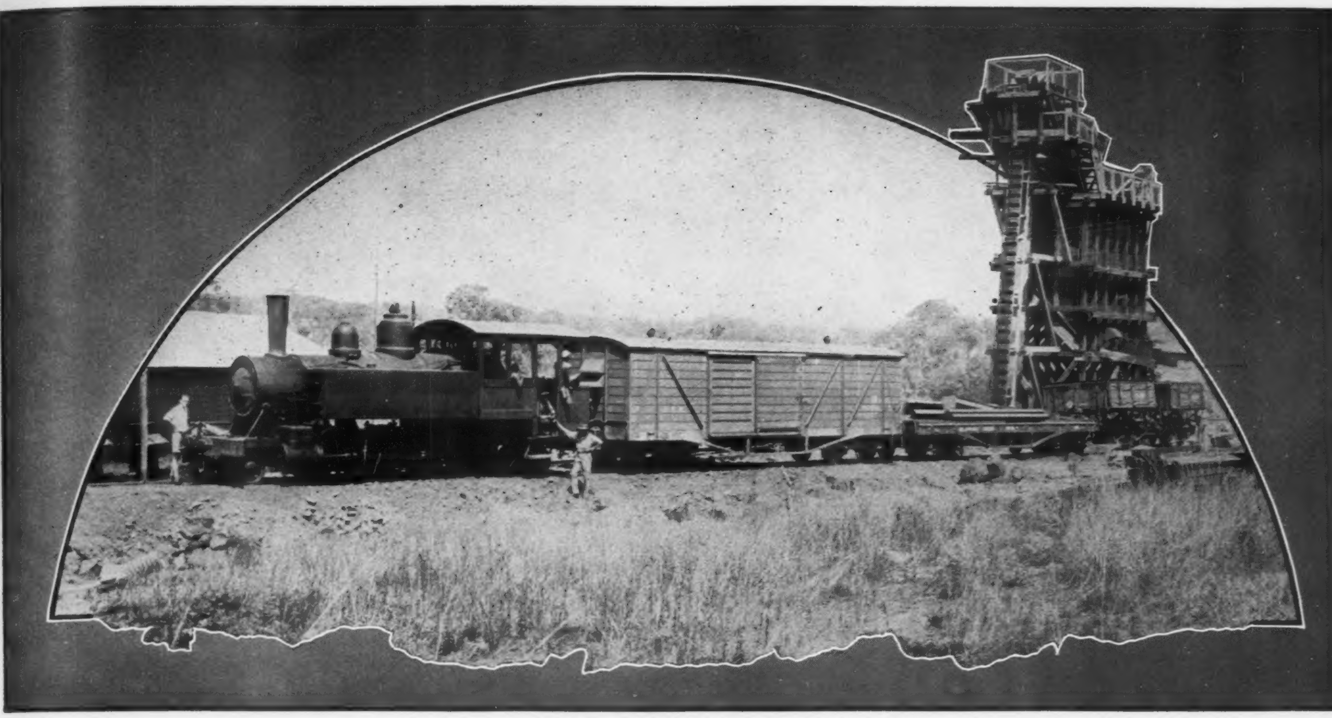
When all was ready, a Type 20 portable compressor arrived with a couple of CC-45 paving breakers, an R-39 "Jackhamer", and a suitable number of steels and sufficient hose. With the Fire Commissioner and members of his staff present, the firemen were first set to work with their accustomed equipment breaking a hole through the concrete wall and cutting similar holes through the concrete floor and the wooden floor—the holes being large enough to draw hose through or to serve as a means of stimulating ventilation. After the firemen had completed their tasks as quickly as they could, then the air tools were called into play. Their performances were so excellent and so speedy that a compressor of the same type, provided with the same tools, was purchased by the Fire Department. This outfit, known as "Air Compressor No. 1", has been assigned to one of the engine companies on the edge of that district in Chicago known as the "Loop".

The compressor has been actively engaged since its purchase and has answered many alarms in various parts of the city. While its primary function is to cut holes for the purposes mentioned, it has also been held in readiness for any fire that might occur in the many tunnels and caissons now under construction, where it might be of vital aid in supplying air to the men "down in the hole". The unit has also been employed in connection with various repair jobs at Fire Department stations, warehouses, shops, etc. Chicago's Fire Department was the first one in the country to be so equipped; and the apparatus has justified its purchase on many occasions.

Probably the compressor's most spectacular service was rendered during the past April, when it was hastily summoned, together with other portables owned by public utilities, to furnish air to men caught underground in a blazing, smoke-filled section of Chicago's sanitary district tunnel. Hour after hour the unit worked without a moment's halt for parts of two days in sending life-giving air into one of the locks provided for security in a menacing emergency. Sixteen men were thus saved and brought to the surface after a period of confinement. Other workers and some firemen who went below to effect rescues were overcome by the fumes and asphyxiated. Compressed air was also sent into the burning tunnel to maintain a pressure of 5 pounds to support its clayey walls.

In the foregoing performance we have again evidence of the adaptability of the portable compressor and the way it can be put to new and unexpected uses. The head of the Chicago Fire Department deserves full credit for his initiative and his foresight in providing a unit that not only has been of much service on many occasions in fighting fires more effectively than formerly but has, as in the case just cited, lent itself to saving life.

Vending machines dispensing 1-gallon cans of gasoline have made their appearance in a western city. Fifty cents in the slot will produce a can—rather a high price to pay for thoughtlessness.



Early stages of development at the Roan Antelope.

Copper Mines of South Africa

By OWEN LETCHER

PART II

HUGE development programs are underway in South Central Africa to make possible large-scale production of copper from the vast deposits of the Congo-Zambesi watershed. It is the purpose of this article to describe the general features of this development and to touch briefly upon the methods of metallurgy that are now in use or contemplated.

Among the important potential producers is the Roan Antelope. Estimated ore reserves are 108,000,000 tons of material, which averages 3.44 per cent copper. A complete plant with an annual capacity of 50,000 tons of "best selected copper" is expected to be ready for operation by next autumn. It is estimated that the total operating costs will permit the delivery of metal at European ports for about 9.1 cents per pound. This company was registered in 1927 to acquire the Antelope and Rietbok claims which, with subsequently added acreage, gave a tract of 1,899 acres. Options on adjoining properties covering 2,675 acres were later taken up, and a further option was secured on another tract of 6,000 acres.

All the properties are contiguous, the ore-bearing rocks occurring around the rim of a trough of hairpin shape. Borings and pits have established the continuity of ore throughout most of the ground, and further exploratory work is in progress. Test runs made in a pilot plant indicate that 91 per cent of the copper content can be recovered in a 51 per cent concentrate. The property has been extensively developed in preparation for the delivery of ore to the crushing plant. A main shaft has been sunk, and underground workings have been fully equipped with the latest types of rock drills, pumps, slushing scrapers, etc.

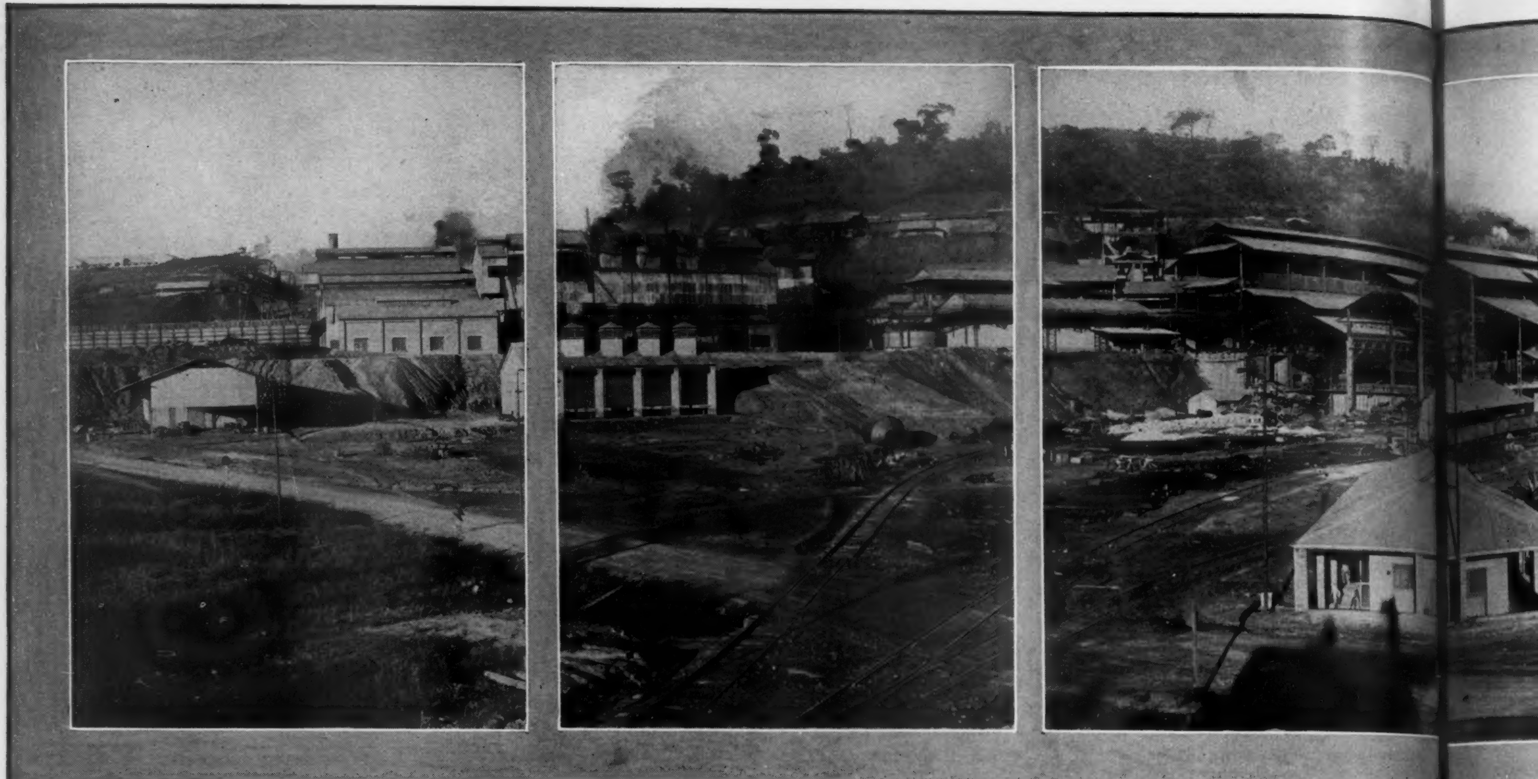
At N'Kana an enormous construction program is well advanced, and the schedule calls for the beginning of operations in June, 1932. The property is being equipped for a production of 5,000 tons of ore per day. Progress has been at an accelerated pace since the completion of railroad connections in May, 1930; and sufficient underground work has been done to indicate the mining conditions that may be expected.

The ore body being developed is a stratified deposit having an average width of 27 feet and an average dip of 45 degrees. The copper content, which averages 4.3 per cent, is remarkably consistent. Development is being carried on from levels at 300, 450, and 600 feet below the surface. The ore body and the country rock adjoining it are medium hard and compact, readily drilled and capable of standing without timbering. Only a moderate amount of water has been encountered. The great width of the ore body and its consistency insure reasonable development costs. Tramming, hoisting, and pumping conditions all favor inexpensive mining.

Heavy steelwork is being placed for the large permanent plant; and almost feverish activity prevailed at the time the property was visited. The headgear of the central shaft was completed late last year. There will be two additional main shafts and four incline shafts. Two winzes are also being sunk from the 450-foot level. The main central shaft will be carried down to the 1,500-foot level. This shaft is 7x35 feet within timbers, is being concreted, and contains five compartments. Four of these will be used for operating 10-ton haulage skips. The immensity of the N'Kana proposition is revealed by the fact that drilling has already indicated the existence of 125,000,000 tons of ore. Extensive portions of the property still remain to be prospected.

At the Mufulira copper mines work is well in hand on a 5,000-ton-per-day plant which is scheduled to be ready for operation about the middle of 1932. So far as the surface equipment is concerned, the opening time could be considerably advanced. Drilling at Mufulira has indicated the presence of 45,000,000 tons of ore of 4.68 per cent copper content. The property covers 9,344 acres; but the estimated tonnage is only for that part of the area which has been prospected to date. The deepest bore hole so far driven in Northern Rhodesia has been sunk on this property. This hole cuts the copper-bearing beds at a depth of 3,000 feet.

The main haulage shaft, circular in cross section and 21 feet in diameter, had been sunk and concreted to a depth of 105 feet when visited last December. The immediate objective of the shaft is the 300-foot level, and the ultimate objective the 900-foot level.



Panoramic view of the metallurgical plant built by the **ere at Panc**

The work is being carried on with a temporary headframe and a sinking hoist. These will be replaced later with permanent structures. The shaft will be equipped with two 10-ton skipways and a 16-foot cageway. The main pumping station is being put in at this shaft. Pumps are being installed to handle 12,000,000 gallons of water every 24 hours.

The Chambesi Mine of the Rhodesian Selection Trust is carrying on development work to open up an ore body about 35 feet wide and containing an average of 3.8 per cent copper. Only a part of the property is included in the present program of exploitation, and that contains approximately 40,000,000 tons of ore. A feature of this mine is the existence in the lower portion of the ore body of a zone of enrichment from 6 to 8 feet in width. The average content of copper in this zone is 10 per cent, and it is estimated that about 3,000,000 tons of ore are in sight.

At the N'Changa Mine development work has been suspended until more adequate power is provided. The ore occurrence there is apparently in the form of a syncline. Both limbs of this structure have been prospected to some extent; and on one of them a shaft has been sunk to a depth of 634 feet, a station cut at the 600-foot level, and a crosscut started. All told, approximately 65,000,000 tons of ore of an average copper content of 3.78 per cent has been revealed. Most of this is of a mixed oxide-sulphide type. Recent drilling operations have been carried on in search for sulphide ore.

Up to May, 1930, a total of 29,000 feet of underground sinking, driving, and crosscutting had been done on various levels of the Kansanshi Mine. These developments extended down to 250 feet. Nearly 20,000 feet of diamond drilling had been carried on down to depths of 900 feet. The proved ores were estimated at 8,000,000 tons averaging 4.15 per cent copper. Deep drilling indicated a similar amount of ores at lower levels. Engineers for the company believe that the property, when fully prospected, will reveal 1,000,000 tons of recoverable copper from ores which can mostly be worked by open-pit methods. The first unit of the projected treatment plant will have a capacity of 2,500 tons of ore per day.

There were many disappointments in the early prospecting work in Northern Rho-

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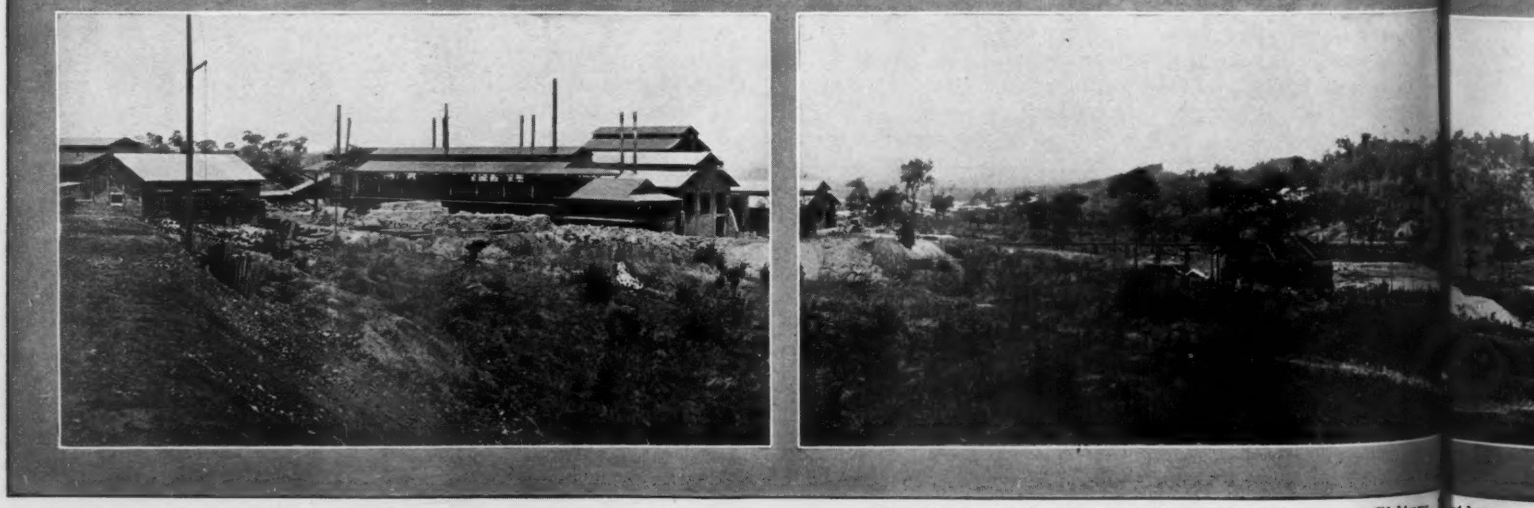


The big leaching plant of the Union Miniere at Chituru **t has an a**

ere at Panda in the heart of the Katanga copper region.

desia. At times it seemed that the entire development might be abandoned because preliminary explorations failed to reveal the true extent and nature of the deposits. Even those men whose persistence is responsible for disclosing the real significance of the ore bodies were often discouraged by the outlook. Only the spirit of optimism and hope that characterizes mining men everywhere drove the work forward in the face of unfavorable evidence.

The first bore hole put down at the Roan Antelope in October, 1926, indicated such poor values that the copper industry of the N'Kana Concession very nearly received its quietus. Repeated failures of the Bwana M'Kubwa to measure up to anything approximating anticipated results was a further disturbing influence. In 1927 the Southern Rhodesian Base Metals Corporation's enterprise in the Sanyati Valley collapsed, and the price of its shares rapidly depreciated to one-fortieth of their former level. The general public did not realize that this concern was operating hundreds of miles from the Northern Rhodesian developments: it considered only the fact that one of the lauded Rhodesian mines had come to grief, and freely predicted that others would do likewise.

In 1928, however, the tide of fortune began to turn. By that time the cumulative evidence of bore-hole data and preliminary development work had begun to make it clear that Northern Rhodesia contained below the poor surface showings a copper field at least as extensive as that being worked by the Union Miniere across the border in the Belgian Congo. It was also apparent that while the ores were not as rich as the Congo deposits they were more consistent in character and constituted a sulphide field which would respond more readily to simple metallurgical procedure than the oxidized ores of the Congo.

It was then that the decision was made to go ahead at full speed. The Roan Antelope launched a development and construction program involving the expenditure of $20,000,000, and other properties laid plans upon proportionate bases. Since then millions of dollars have poured into the field and much has been accomplished. The all-enveloping forests have been cleared, immense technical and administrative organizations have been created, branch railroad lines have been

t has an annual capacity of 35,000 tons of electrolytic copper.

built, and great power and treatment plants and tall headgears have risen out of the bush. Below ground, rock drills and other compressed-air machines are preparing the development of the various mines for stoping the ore on mass-production scales of operation.

Many things are involved in carrying out the development programs. These copper belts lie within the tropics, and provisions must be made to safeguard the health of the workers. Eminent specialists have been retained to investigate health conditions and to study tropical diseases. Extensive plans have been devised to insure proper housing and food. Swamps have been drained, hospitals built, recreation halls, libraries, and athletic fields provided. Hundreds of miles of roads have been constructed.

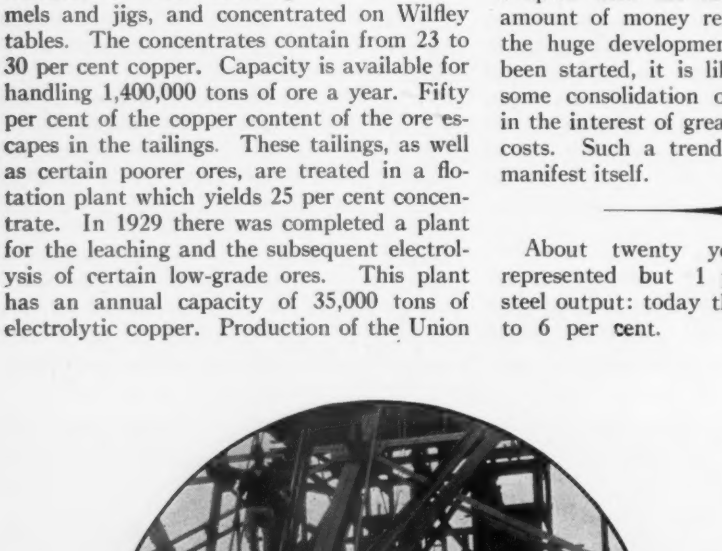
As has been indicated, the program includes the setting up of adequate treatment plants to produce metallic copper from the ores. To insure the provision of proper processes and equipment, pilot plants have been erected and operated and a great amount of research work has been done.

At the properties of the Union Miniere in the Belgian Congo, only rich lump ore having a copper content of 15 per cent and over is smelted directly. Until 1921 this was the only class of ore utilized. It was not economical to smelt lower-grade ores because of the high fuel cost and the presence of silicates in the ore. The erection of a concentrator at Panda made it profitable to treat ores above 6 per cent in copper content. The ore is crushed, classified according to size in trommels and jigs, and concentrated on Wilfley tables. The concentrates contain from 23 to 30 per cent copper. Capacity is available for handling 1,400,000 tons of ore a year. Fifty per cent of the copper content of the ore escapes in the tailings. These tailings, as well as certain poorer ores, are treated in a flotation plant which yields 25 per cent concentrate. In 1929 there was completed a plant for the leaching and the subsequent electrolysis of certain low-grade ores. This plant has an annual capacity of 35,000 tons of electrolytic copper. Production of the Union Miniere in 1929 was 135,539 tons of copper.

Since the bulk of the ores that will come from the new Northern Rhodesian mines are straight sulphides, there will be little requirement for special treatment. It was deemed advisable, however, to proceed with caution, and to that end small experimental plants preceded the construction of permanent plants. These pilot plants have obtained a high percentage of extraction and have yielded concentrates containing more than 50 per cent copper. The ores are easy to crush and grind, insuring a moderate power cost for these operations. They respond readily to the flotation process with a low consumption of chemicals.

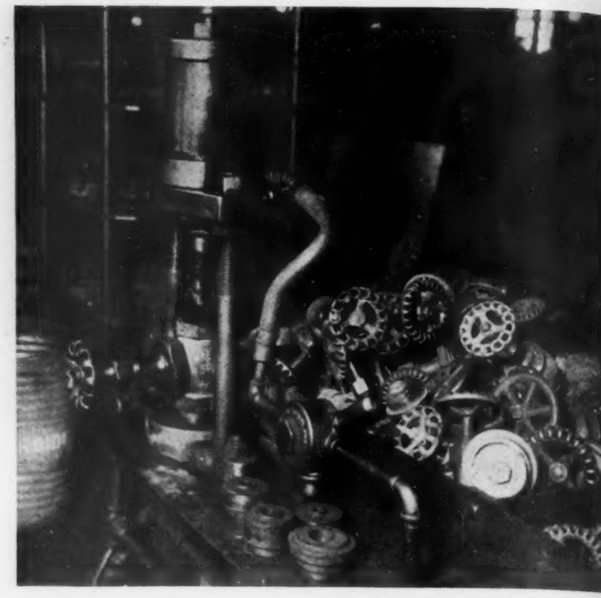
In some sections of Northern Rhodesia are encountered tonnages of mixed ores—that is, oxidized ores in association with sulphides. To treat these satisfactorily there has been developed after several years of experimenting a special process known as the segregation process. It is claimed for it that it will extract 92 per cent of the contained copper.

Because of the present low price of copper, coupled with the fact that a considerable amount of money remains to be raised for the huge development programs that have been started, it is likely that there will be some consolidation of operating companies in the interest of greater efficiency and lower costs. Such a trend has already begun to manifest itself.



Portable compressor supplying power for riveting headframe at the N'Kana Mine.

About twenty years ago alloy steels represented but 1 per cent of the entire steel output: today the percentage amounts to 6 per cent.



Courtesy, Railway Mechanical Engineer
Improved way of giving globe valves a service test.

TESTING GLOBE VALVES WITH AIR UNDER PRESSURE

THE work of determining the tightness of locomotive globe valves in the Chicago shops of the Chicago & North Western has been much simplified by the development there of a device that puts the valves to a water test without the labor of screwing them separately on to a test line, which is the common practice. The device is pneumatically operated. It consists of a small air cylinder mounted on a base plate through which passes an air pipe that connects with the main air line. Attached to the plunger of the cylinder is a cross bar to hold in place the valve being tested. Compressed air is admitted to and exhausted from the cylinder by means of a 3-way valve suitably equipped with handles. As the sizes of the globe valves vary, false seats with leather gaskets are provided.

After a valve is properly seated and spotted on the base plate, the plunger is brought down on top of it by admitting air to the cylinder at from 90 to 100 pounds pressure. Thus firmly held in the machine, the cavity in the upper part of the valve is filled with water to which air pressure is then applied from beneath. If there be any leak or leaks in the valve that fact will at once be noticeable. A somewhat similar machine has been devised and put to use in the same shops for the testing of angle valves.

Asbestos rope is said to be a very useful thing when it comes to fighting oil and gas fires, as it helps to reduce the hazards of what is undoubtedly a dangerous procedure. The noninflammable line is stretched across the sea of flame, and from it is suspended by a length of the same kind of rope a bomb of nitroglycerine. This bomb is run along the line until it hangs in the midst of the blaze. Then the detonator is set off—the explosion generally being of sufficient force to blow out the flame.

Air, Water, and Steam Speed Pile-Driving

CONTRACTORS, as a rule, are interested in learning how their fellow contractors do their work because what one has conceived and found of use on a specific job may prove profitable to another.

In building three concrete-pile bridges on a Federal Aid project, at Dale, Okla., Leo C. Sanders, a contractor of Oklahoma City, set 200 concrete piles, laid steel I-beam stringers, poured 1,500 cubic yards of concrete flooring, and placed 50,000 cubic yards of earth fill to connect the bridges with a state highway, in the span of 143 days. All this work was done with comparatively little equipment—main reliance being placed on three Bucyrus-Erie gas-air machines. These machines, because of their adaptability, were used variously as pile drivers, draglines, cranes, and clamshells.

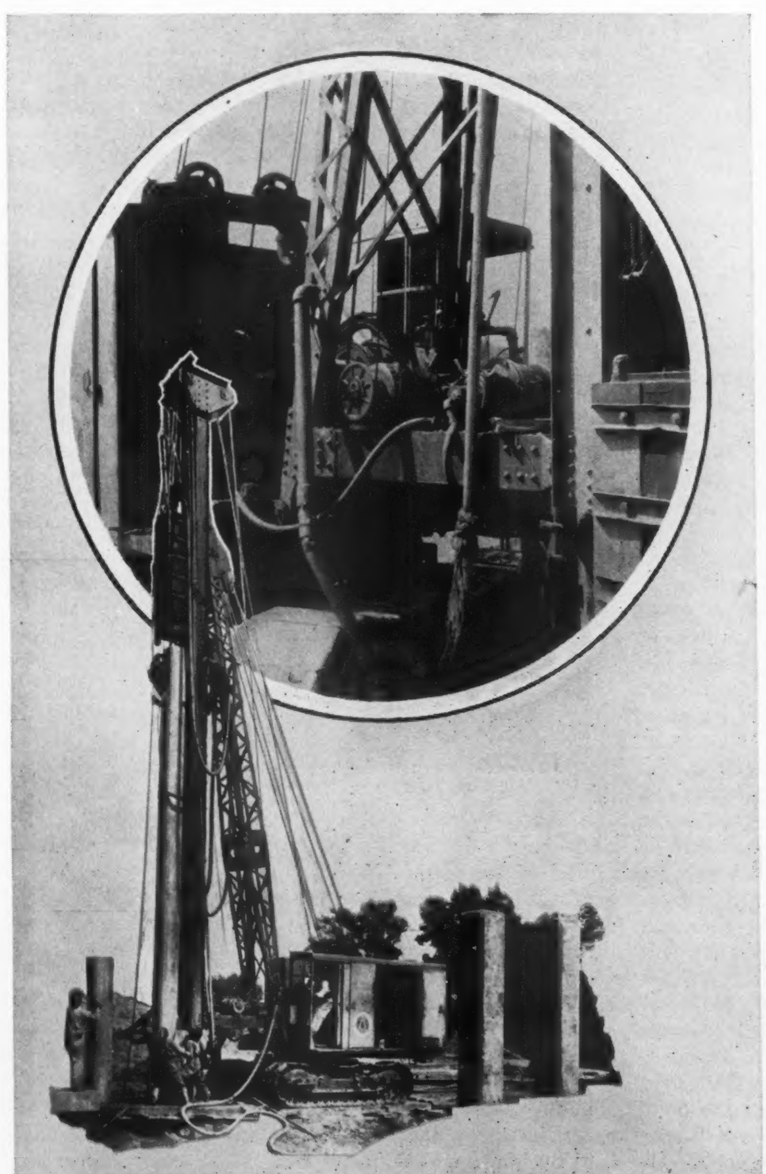
The piles were cast by the contractor at the scene of operations, thus obviating transport charges; and each was 16 inches square, 35 feet long, and weighed 10,000 pounds. For their driving, one of the gas-air machines was converted into a steam hammer—that is, it was equipped with a McKiernan - Terry hammer mounted in a steel guideway nearly 50 feet long. This guideway was made of a standard 18-inch I-beam with a 12-inch standard channel riveted to each flange of the I.

The earth formation at the bridge sites was such as to permit jetting to facilitate the pile-driving operations. To do this with the least trouble and delay, a pipe was carried three-quarters of the way up through the box-girder boom. At its intake end this pipe was connected by a 3-inch line to a duplex steam pump drawing power from the same boiler that supplied steam for the hammer, and at its upper end it was provided with a tee to which were attached two 50-foot lengths of 2-inch high-pressure hose, each terminating in a water jet. In this manner the water was conveyed up the guideway and thence down to the ground alongside the pile in process of driving.

The work of raising and lowering the 50-foot lengths of hose agreeably to service requirements was given over to two small air hoists of the Ingersoll-Rand type. These hoists were mounted, as an accompanying illustration plainly shows, on a platform resting on braces between the foot of the boom and the guideway, and were connected to the compressed-air line that feeds the swing engine of the Bucyrus-Erie. Each hose could thus be handled independently, making it possible to quickly change the positions of the water jets—that is, hold one higher than the other—so as to concentrate excavating at one or the other side of the pile in order to keep the pile vertical during its descent. To make for ease of operation, the throttle valves of both the steam and the water lines were placed just in front of the control levers of the gas-air machine.

Not infrequently a pile had to be dragged 50 to 100 feet from where it was cast to the bridge site. In that case, the pile driver acted in the capacity of a dragline. For this purpose the hammer was lowered to the ground, and the cable detached and fastened to one end of the pile. In this way the piles were readily hauled to the point of use as they were needed. With the machine once more in order for pile-driving, the hammer and the pile were picked up together and raised to the desired height. After that the pile was spotted and the water and the steam turned on. Except for the control of the water jets to guide the pile, the work of driving it to grade was more or less mechanical.

With all the piles for a bridge in place, and with the caps poured, the pile driver served as a crane and proceeded to lay the steel stringers for the floor; and as soon as the carpenters had started building the forms for the concrete slab, the selfsame machine was equipped with a clamshell bucket and employed for charging the batcher plant that supplied the mixer. Operating as draglines, the two other gas-air machines on the job were kept busy handling the 50,000 cubic yards of earth fill.



Top—Close-up of the air hoists that handled the water-jet lines during pile-driving. Bottom—The combination pile driver, dragline, crane, and clamshell Bucyrus-Erie machine setting up a pile preparatory to driving.

LINING STEEL TUBING WITH OTHER METAL

STEEL tubes lined with metal by a special centrifugal process are being manufactured by the Detroit Seamless Steel Tubes company, which, according to a recent announcement, has acquired the exclusive rights to that process in the United States. It is claimed for the product that the lining metal and the steel shell are so inseparably bonded by fusion that they are as one and remain so even when subjected to very rough treatment.

Turnings made from the end of a seamless steel tube so lined will, it is said, curl off the tool showing both textures of the bonded metals as a continuous strip without fracture at any point between the two. In the case of linings of malleable metals, efforts to destroy the union by splitting and rolling the finished tubes proved unavailing. In fact the bond held even when the tubes were worked into different forms, manipulated in one way or another, or turned inside out.

Obviously, there is a wide field of application for seamless steel tubes lined with other metals that are proof against corrosive attack or that will add strength to the walls.

More than 50 per cent of the world production of sulphur is consumed in the United States.

WILLIAM L. SAUNDERS

WILLIAM Lawrence Saunders died in Teneriffe, Canary Islands, on June 25, in the course of a leisurely journey around the world. At the time of his demise, Mr. Saunders was Chairman of the Board of Directors of the Ingersoll-Rand Company, with which he had been identified for a goodly number of years. Mr. Saunders' death brought to a conclusion a career marked by many and varied activities; but he will probably be longest remembered at home and abroad by reason of the part played by him in the advancement of the use of compressed air for power purposes and in the devising of facilities or apparatus employing the energy of that adaptable medium.

Mr. Saunders was born in Columbus, Ga., on November 1, 1856. He was the son of William Tredell Saunders, D.D., and Eliza Morton Saunders. After he had completed his preparatory schooling he became a student at the University of Pennsylvania, from which he was graduated in 1876 with the degree of bachelor of science. The honorary degree of doctor of science was conferred upon him in 1911 in recognition of the eminent position he had won for himself as an engineer.

Before his graduation, Mr. Saunders was editor-in-chief of the *University Magazine*, as well as class poet. In 1876 he engaged in newspaper work in Philadelphia, and was a special correspondent for some southern newspapers during the Centennial Exposition. At that time he made two balloon ascensions; and it is said that he reached an altitude of several miles, where he remained all night. Evidence of his initiative and grit.

Between 1878 and 1882, Mr. Saunders was engaged in building docks, excavating a channel, and erecting warehouses for the National Storage Company, at Communipaw, N. J., in New York Harbor. The channel work called for the drilling and blasting of considerable subaqueous rock; and to speed up operations Mr. Saunders devised apparatus that subsequently were adopted generally in kindred undertakings. During the earlier stages of the underwater rock work, a diver was employed to do the drilling. The diver, so it is reported, was temperamental, and he descended to the harbor bed only when the mood moved him. His independence was costly, because it slowed up operations generally wherever they were dependent upon drilling and blasting. Refusing to go underwater when so directed by Mr. Saunders, the diver was promptly discharged. That was good discipline, but the situation became disquieting when no other diver could be found to carry on. In this predicament, Mr. Saunders bought a diving dress and proceeded, offhand, to qualify for subaqueous duty. Possibly his youth caused him to make light of the hazards involved. Anyway, he made good; and the experience was turned to advantage by him in developing equipment to expedite the drilling of rock underwater.

As a lifelong friend has said of him: "His aggressive work in so many fields of human thought and action was so great in the aggregate that it was impossible to think of him as in any sense a special worker in any. He wanted to be in everything, and he got there; and not only his presence but his telling help were recognized and appreciated. He was a 'Jack of all trades', as we might say, in headwork as others are in mechanical craft." In the evolution of the rock drill, Mr. Saunders became acquainted with that tool in its crude early days, and he was identified with its gradual development in its diversified forms as the world knows it now. He had a personal part in the conception of the radialaxe system of coal mining; and he invented apparatus for Ingersoll track and bar channelers and gadders for quarrying stone—further proof of his versatility and engineering skill.

Mr. Saunders was the author of a number of engineering works having principally to do with the applications of compressed air in divers fields of service; and for a while he edited *Compressed Air Magazine*. He was a figure in the political life of New Jersey, where he resided at North Plainfield; and he was twice mayor of that community. During the period of the World War he was first a member and then chairman of the Naval Consulting Board; and his able work in connection with that organization was recognized

William Lawrence Saunders.

and appreciated by President Wilson. Mr. Saunders was associated with the Ingersoll-Sergeant Drill Company in the days when that concern was feeling its way in developing rock drills and compressors; and in time he successively became secretary and vice-president of that organization. He became president of the Ingersoll-Rand Company when that company was incorporated in 1905.

We have sketched only some of the outstanding aspects of Mr. Saunders' notable career. Among the many important offices held by him might be mentioned the following: member, American Institute of Mining and Metallurgical Engineers; member, New Jersey Harbor Commission; past president, American Manufacturers Export Association; life member, American Society of Civil Engineers; member, American Society of Mechanical Engineers; past president, United Engineering Society; member, National Foreign Trade Council; director, New York & Honduras Rosario Mining Company; director, Sabana Grande Honduras Mining Company; member, New York Chamber of Commerce; member, American Iron and Steel Institute; and fellow of the American Geographical Society. Mr. Saunders founded the Mining Medal to recognize achievements in mining; and he was a member of numerous clubs.

Mr. Saunders was a man of much personal charm; and his grace of manner had much to do in gaining for him that host of friends and admirers who will regret deeply his passing.

RUDOLPH W. RUSTERHOLZ

RUDOLPH W. Rusterholz, affectionately known as "Rusty" by his very numerous friends, died, after a brief illness, on June 1[illegible] at his home in Johannesburg, South Africa. His passing has caused deep regret among all that have had the pleasure and the privilege of knowing him. Rusty was the type of man that quickly won the regard of others. He had initiative, force, and a natural gift of leadership; and to these characteristics was added that of personal charm. His whole life was one of action; and the record of his 54 years is a full one.

He was born in Peoria, Ill., in 1877; and in his twenty-first year he saw service in the Spanish-American War in Cuba with the Third United States Engineers. He was, therefore, somewhat older and of riper experience than the average college student when he entered Purdue University in the fall of 1902. Between leaving the army and entering the university he had worked at various jobs in paving the way for the professional training he was bent upon acquiring.

While at the university he did not take part in athletics; but for two years he was manager of the Athletic Association, was responsible for all athletic finances, and took care of the business end of the various trips made by the athletic team. Rusty was made editor-in-chief of the *Purdue Exponent*, the daily paper of the institution, and in his senior year he was editor of the *Debris*, the annual publication of the senior class. He did these several things in addition to making acceptable grades in his studies and while virtually earning his way through school. He was popular among his fellow students and he was likewise esteemed by the faculty. After his graduation from Purdue he joined the force in the Chicago office of the Ingersoll-Rand Company; and following a few years of work there he was sent to Butte, Mont., as manager of the Ingersoll-Rand Company's office in that copper-mining city.

True to his energetic nature, he went to France during the World War and was a captain in the air service, doing the duties assigned him with his accustomed thorough-

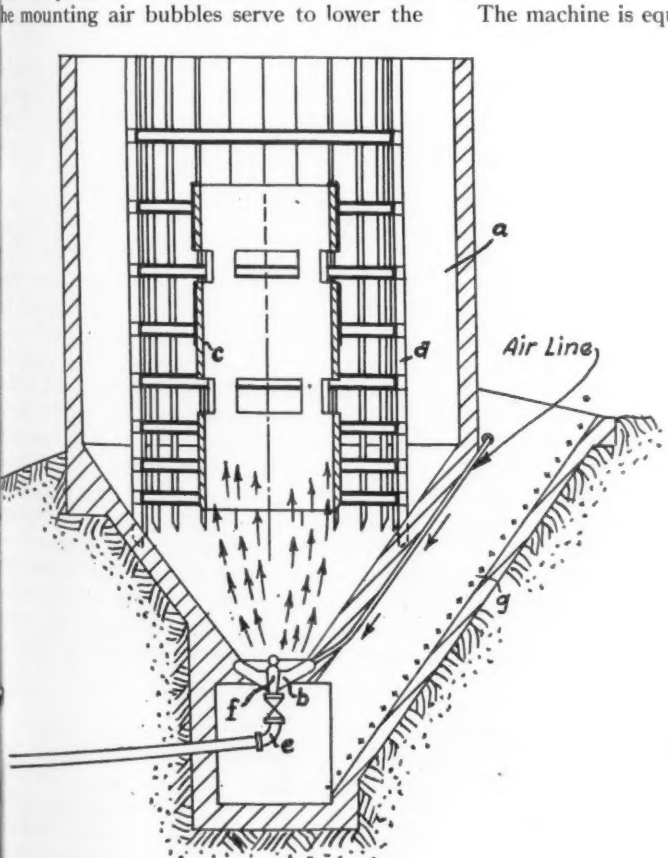
ness and efficiency. He was one of the corps of technicists associated with the United States Peace Commission in Paris following the close of that conflict. In 1919 he became manager, at Johannesburg, of the Ingersoll-Rand Company's activities in South Africa, winning for the company he represented and for himself the high regard of all with whom he became associated in the course of his twelve years of service in that country. He was president of the only Rotary Club in Africa, and was also president of the United States Chamber of Commerce in Africa. Mr. Rusterholz was married in 1912 to Nila Kabat, who survives him. Two of his sisters, Mrs. Lydia R. Martin and Mrs. Margaret Hayes, reside in Peoria, Ill., and a third sister, Mrs. Hannah Binckels, lives in Zurich, Switzerland.

PNEUMATIC CEMENT-SLURRY MIXER OF IMPROVED TYPE

FROM abroad comes the news of the application of an improved method of agitating slurry in the manufacture of cement. The mixing of the more or less viscous mass is done with compressed air; and the advantages claimed for the process are simplicity and exceptionally low operating cost.

The mixer, as the accompanying cross-sectional drawing shows, consists of a reinforced-concrete cylinder with a conical bottom in which is fitted a 2-walled dished disk, the upper half of which is perforated to permit the flow of compressed air into the tank. In this cylinder is placed concentrically a large-diameter riser tube. When the tank is filled with slurry to a point above the riser tube, and compressed air is admitted from below, the mounting air bubbles serve to lower the specific gravity of the mass in the tube, thus setting up a movement akin to that of an air lift and effectually mixing the contained slurry.

If the tank is to be used for stirring and for the admixture of dry material as well, a cylindrical screen, also arranged concentrically, is built into it. The dry material is added while the mixing is going on; and, as the work progresses, it slowly settles in the space between the tank and the screen, finding its way through the screen into the chamber adjoining the riser tube. There the dry stuff is caught up by the agitated slurry and thoroughly mixed with it. As the slurry is needed it is drawn off through a discharge pipe in the bottom of the cone—suitable means being provided for the opening or closing of the outlet. The lower part of the concrete tank is made accessible by an inclined shaft.



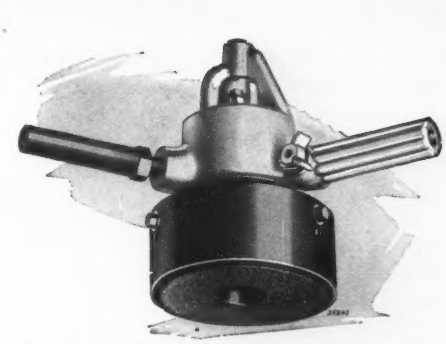
Air-operated slurry mixer; a, reinforced-concrete cylinder; b, air discharge; c, riser tube; d, cylindrical screen; e, slurry discharge pipe; f, slurry outlet; g, inclined shaft.

IMPROVED GRINDER AND SANDER OF MULTI-VANE TYPE

AN IMPROVED multi-vane type of grinder and sander, designated Size 4F, has been added to the Ingersoll-Rand line of products. It is claimed for this machine that it is powerful, smooth running, and light in weight—qualities that make for efficiency in service.

The 4F can be fitted, as required, with a grinding wheel, a sanding head, or a wire brush, and is therefore suitable for many uses, such as polishing automobile bodies, smoothing down welds, cleaning and surfacing large castings, sanding metal furniture, dies, and other metal or wood surfaces, etc., etc.

The machine is equipped with two handles so that it can always be held at right angles to the work. One of these handles may be detached to facilitate operating in close quarters: the other serves as the air inlet and is fitted with a thumb-controlled throttle valve. The standard free speed of the tool is 4,600 revolutions per minute; but units can be furnished for higher or lower rates of speed. Overspeed is prevented by a governor. Without the adjustable guard for grinding wheels, the Size 4F weighs 10¾ pounds and has an overall length of 9¼ inches.



Light-weight multi-vane grinder and sander with the detachable handle in place.

PERFECTING MAGNETIC IRON

THE nature of the iron or steel used in certain parts of electrical apparatus affects more or less radically the operating efficiencies of those machines. That is to say, the choice of metals either promotes or reduces electrical losses. This is especially true of cores of generators or motors subject to heating in service and likely, therefore, to undergo changes in their essential magnetic properties.

It was commonly recognized that impurities in iron have an effect on its magnetic properties; but beyond that there was little known concerning the quantitative relationship between different impurities and resulting magnetic changes. This was the status of the art, so to speak, when more than fifteen years ago, a young electrical engineer of the name of T. D. Yensen—then a student at the University of Illinois—became interested in the subject and essayed to make in a vacuum furnace iron alloys of the purest materials obtainable. After fairly protracted experimenting, he succeeded in producing in the laboratory products possessing notable improvements in their magnetic properties. What followed is quoted from a recent issue of *Research Narratives* published by the Engineering Foundation.

At the request of the Westinghouse Company, he transferred his activities to the East Pittsburgh Research Laboratories, and has since then worked on this one subject exclusively, paying particular attention to the effect of minute impurities on magnetic properties. One of his main objects has been to determine the properties of really pure iron, because iron is the basis of all important magnetic materials. He has found, for example, that a hundredth of a per cent of carbon has an almost unbelievably large effect on the magnetic properties of iron. Who would have believed that the elimination of a few thousandths of a per cent of carbon

could be responsible for raising the maximum permeability of iron from perhaps 10,000 to 50,000 with corresponding decreases in hysteresis? Yet this has been amply demonstrated by his work. He can select two bars of iron that an expert chemist cannot distinguish by the best analytical methods available, and yet, when placed in the magnetic testing apparatus, one of them will show magnetic permeabilities one hundred times greater than the other.

The work has been fraught with exceptional difficulties, since it dealt with subjects like strain in the crystal structures, and with impurities in thousandths of a per cent. Furthermore, these very small amounts of oxygen, carbon, and sulphur exist in solution in solid iron like sugar in solution in a glass of water. Successful in removing carbon, there still remained the more difficult task of removing oxygen. Dr. Yensen employed a unique method. He introduced a little carbon, harmful in itself, to form carbon monoxide, which can be drawn off by vacuum treatment. If too much carbon is used, the excess carbon is removed by annealing in hydrogen.

Commercially, Dr. Yensen's most important results have come from the study of iron-silicon and iron-nickel alloys. Laboratory results are not rapidly translated into commercial practice. Five years after his first published results, no appreciable effect appeared in commercial steel. In 1920, after much discussion and many experiments, the steel mills began to put some of the findings into practice. There has since been a steady annual improvement in the quality of electrical sheet iron until now the commercial material is almost as good as the laboratory product of a few years ago.

Hipernik, an alloy of half iron and half nickel, is another product closely connected with Dr. Yensen's activities, and was named by him. At first used in high-quality radio receiving sets, where it contributed largely to the elimination of distortion of sounds in reproduction, it has gradually entered other important fields. In the near future we may find this alloy in many places where iron-silicon alloys are now used. Here again the difference between the ordinary alloy and Hipernik could not be ascertained by the usual chemical analysis: radically new methods had to be devised.

In its large practical results, this long and painstaking research is a vivid example of how the affairs of men are affected by scientific work which only a few years ago would have appeared hopelessly theoretical.

Despite the fact that there are some very long transmission lines in the United States, a kilowatt-hour travels an average distance of but 22 miles between the power house and the consumer, according to the National Electric Light Association.

High-speed-steel wood-planer knives plated with chromium have proved upon test that they will outlast the common run of knives of this kind by as much as 25 per cent when operating on kiln-dried lumber.

MODERN DIESEL ENGINE PRACTICE, by Orville Adams. A copiously illustrated book of 656 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $6.00.

THE author, who is a consulting Diesel engineer, has brought together in this book the essence of notes and data gathered by him during several years of his professional practice. Mr. Adams pictures a wide and steadily growing field of service for the Diesel engine; and one of his reasons for writing this book has been to furnish information to steam-power engineers who must, as he conceives it, inevitably have to take over the management of substituted Diesels. As he expresses it: "It is apparent that these men will want to know definitely the fields of application and past history of this efficient and comparatively new prime mover; its general and special operating principles; the construction and design of the different types of Diesel engines, as well as the best practice in modern Diesel engine installation, operation and maintenance, operating costs, repair and upkeep." As far as it is practicable in an art characterized by continual improvement, the author has tried to make this book more comprehensive and up to date.

TREATISE ON LEATHER BELTING, by George B. Haven and George W. Swett. An illustrated book of 249 pages, published by the American Leather Belting Association, New York City. Price, $1.50.

DESPITE the fact that the leather-belting industry began its career in 1858, still there has not heretofore been brought together in a single volume such a fund of reliable engineering information concerning the manufacture and the uses of leather belting in a form that would be readily helpful to the man in the shop, to the seasoned engineer, and to the student. One has but to recall the very extensive employment of leather belting as a means of transmitting mechanical power to grasp the fact that a better and wider knowledge of leather belting will make not only for longer service life but for more efficient performance at all times. We believe this volume fills a long-felt want.

NOW WE'RE LOGGIN', by Paul Hosmer. A book of 210 pages, published by the Metropolitan Press, Portland, Ore. Price, $2.00.

THE author has not only introduced to the world at large the intimate life of the lumberjack—about whom most of us know comparatively little, but he has succeeded in doing this in an extremely humorous way. We find that even among these hard-fisted, hard-living, hard-working toilers there is time for fun and moments of both subt and boisterous mirth.

To quote from a foreword: "Senile critic for the most part suffering from liver troub and hardening of the arteries, have of la years moaned that there is no humor amo lumberjacks any more......This libel on race of great and rugged men has gone u challenged for far too many years. But i this book Mr. Hosmer has for once and a spiked the damnable slur and has banke and gavelled the doddering critics in a mann they well deserve." The author knows h subject, and he has done a good job in h colorful portrayal of these men in the timbe lands and of the higher-ups in the lumber in dustry.

Trade Standards adopted by The Com pressed Air Society. This illustrated bookl of 47 pages is the fourth edition so far issu of *Trade Standards* and can be obtained a the office of the society, 90 West Street, Ne York City, for 50 cents a copy. The ne material in the pamphlet comprises a formu for use in air-compressor testing; suggestio in connection with the installing and operati of air compressors; caution against the em ployment of old boilers or tanks as air r ceivers; suggestions for handling very co cooling water so as to prevent condensatio and undue wear on air cylinders; and vario other data likely to be of service to the owne and users of pneumatic equipment.

Wind Pressure on Circular Cylinders a Chimneys, Research Paper No. 221 issued b the United States Bureau of Standards a obtainable from the Superintendent of Doc ments, Washington, D. C. Price, 15 cen This paper contains a summary of the pu lished model experiments on cylinders a of some previously unpublished experime made at the National Bureau of Standar on models, on a large cylinder in natur winds, and on a power-plant chimney i natural winds. This information is collect and analyzed for the purpose of estimati the wind pressure on chimneys and oth cylindrical structures at known wind speed

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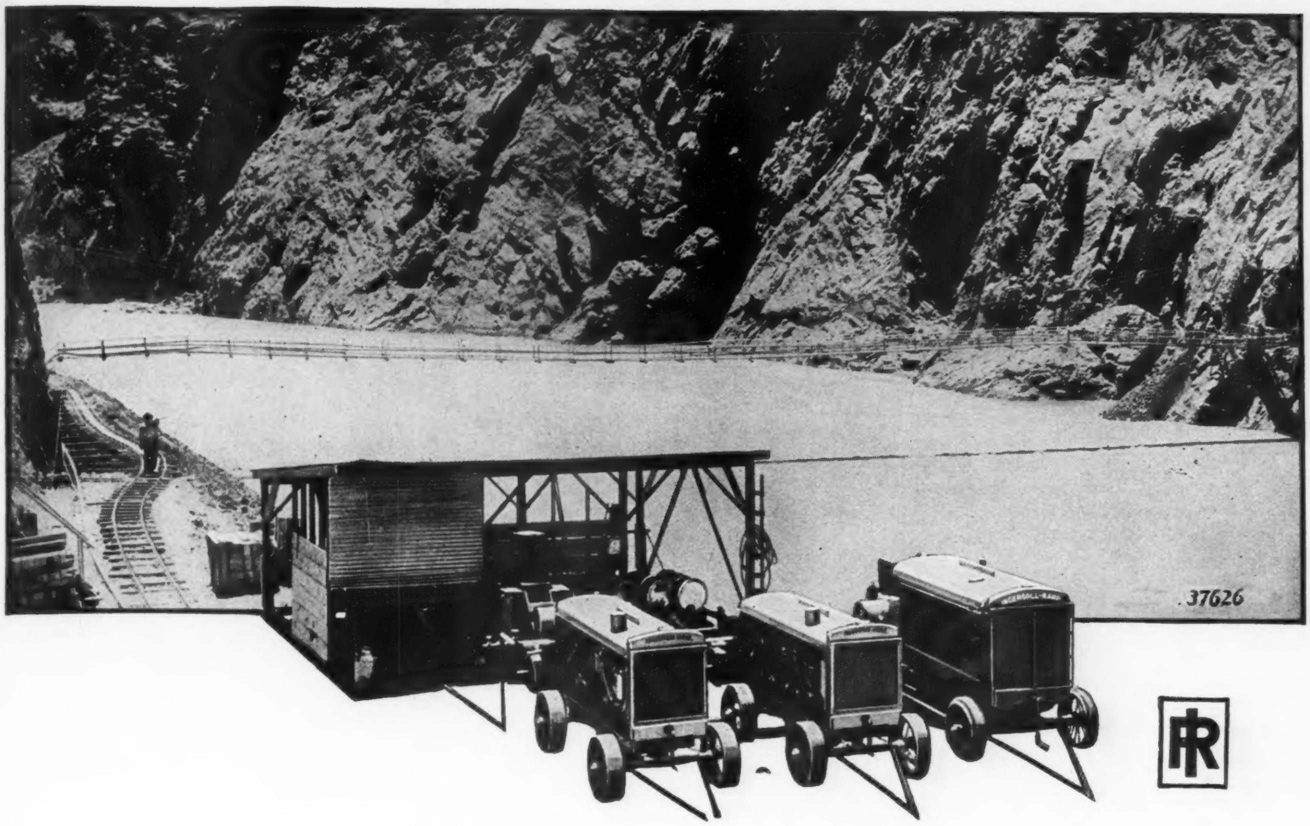
Easton Car & Construction Company Easton, Pa., has just issued its Bulletin No 40, which is descriptive of truck bodies bu by that company for quarry service. Thi subject should be of interest to many. A cop of the Bulletin can be had gratis upon reque



STARTING WORK AT THE HOOVER DAM

The three Ingersoll-Rand Portable Compressors illustrated above are furnishing compressed air for the initial stages of the tunnel-driving operations at the Hoover Dam site.

An adit is being driven into the canyon wall near the point shown. From this opening, headings will be started both ways on two of the four 57-foot tunnels that will divert the waters of the Colorado River while the dam and power houses are being constructed. Two additional tunnels will be bored through the opposite canyon wall.

Six Companies, Inc., are using 18 I-R Portable Compressors to get a quick start on their 5-year, $49,000,000 job. Meanwhile work is in progress on the erection of the battery of I-R stationary compressors which will supply air throughout the life of the contract.

Ingersoll-Rand compressors, rock drills, and other equipment were chosen for this huge government undertaking because of the consistent reliability they have shown for more than half a century in world-wide service.

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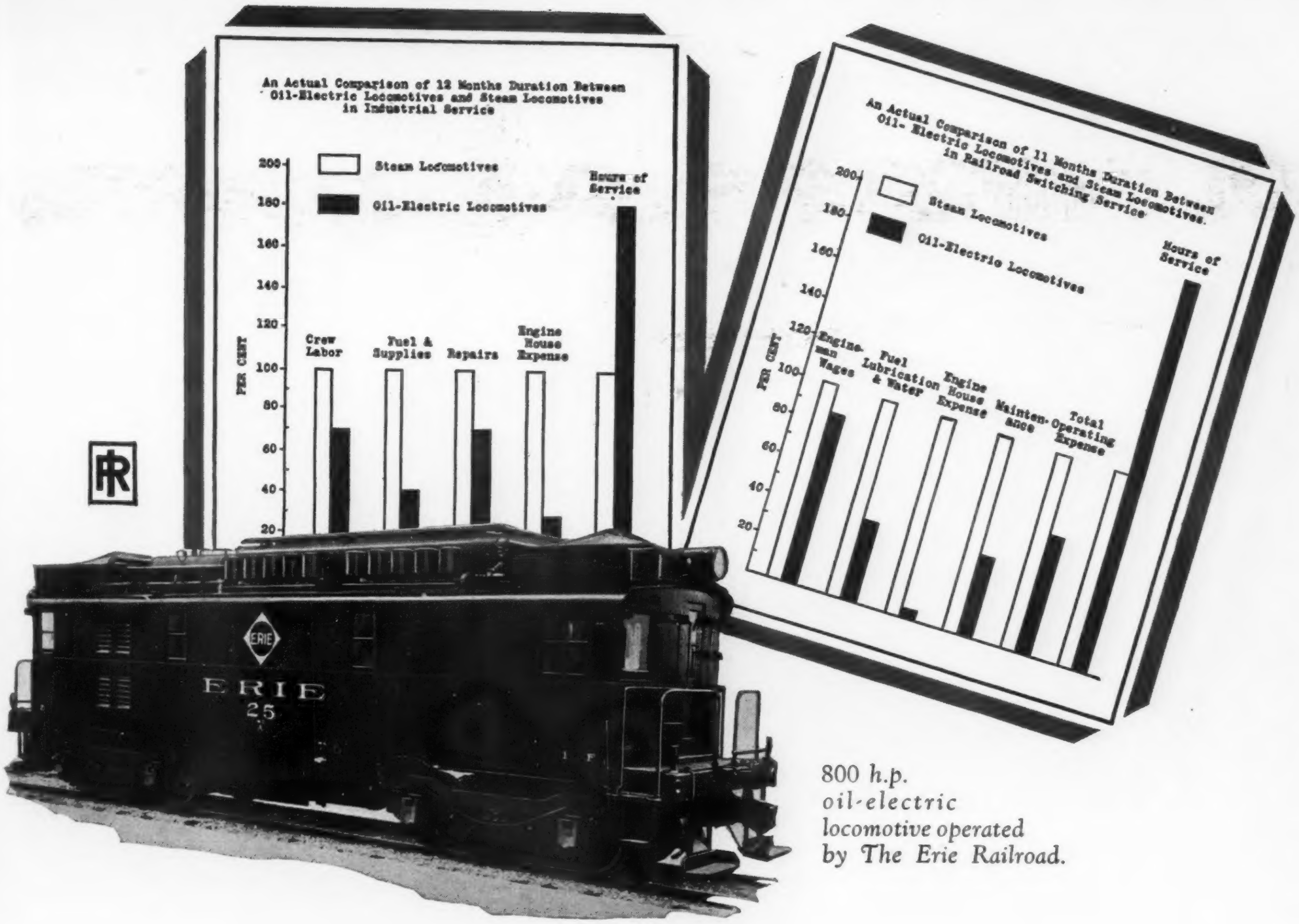

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